The Commercial Geoduck Clam Fishery in British Columbia 1981 to 1984

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ABSTRACT

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Geoduck clams are harvested commercially by divers using hand-held, high pressure water jets, guided and controlled underwater by a diver to displace the substrate surrounding individual clams. The fishery is managed by annual quotas to maintain a sustainable yield. Licence limitation reduced the fleet to 54 G-licence vessels.

The commercial fishery in British Columbia has landed 18,518 t over the period 1976 to 1984. Landings reported in 1981 were 2,704 t for $2.2 million, in 1982 were 3,134 t for $2.8 million, in 1983 were 2,636 t for $1.8 million and in 1984 were 3,482 t for $2.9 million. Approximately 90% of the total landings from 1976 to 1984 have come from the south coast, with 58% landed from the west coast of Vancouver Island. Only 10% of the total landings have come from the north coast where fishing began in 1980. The total harvested area to 1984, as estimated from fishermen's logs, is approximately 10,180 ha in the south coast and 704 ha in the north coast.

Quotas were introduced in 1979 when effort and landings had greatly increased and there developed concerns for possible local overharvesting. In order to maintain sustainable yields and a remnant population of 50 percent of the original biomass, it was later recommended that quotas be kept within 0.75 to 2 percent of the virgin biomass.

Two vessels were licenced in 1984 to process their own catch at sea, north of Cape Caution where processing facilities are limited and a loss of quality occurs in transporting the clams to shore based facilities.

Further stock assessment reviews are required, particularly in the north coast region, as well as an investigation on the effects of fishing on recruitment.

Key words: geoducks, clams, shellfish, British Columbia, commercial fishing.

RESUMÉ

Les panopeas du Pacifique son exploités commercialement par des plongeurs qui utilisent des jets d'eau à haute pression tenus à la main, orientés et contrôlés sous l'eau par un plongeur pour déplacer le substrat qui entoure les coquillages. La gestion de la pêche se fait par l'établissement de contingents annuels afin d'assurer un rendement soutenu. La limitation du nombre de permis a réduit la flottille de pêche à 54 bateaux détenteurs d'un permis G.

De 1976 à 1984, les débarquements commerciaux en Colombie-Britannique se sont élevés à 18 518 tm. Les débarquements signalés en 1981 ont été de 2 704 tm, d'une valeur de 2,2 $ millions, en 1982 de 3 134 tm, d'une valeur de 2,8 $ millions, en 1983 de 2 636 tm, d'une valeur de 1,8 $ millions et, en 1984, de 3 482 tm, d'une valeur de 2,9 $ millions. Environ 90% de tous les débarquements effectués entre 1976 et 1984 provenaient de la côte sud et 58% ont été débarqués sur la côte ouest de l'île Vancouver. Seulement 10% des debarquements provenaient de la côte nord, où la pêche a débuté en 1980. De 1978 à 1984, les pêcheurs ont signalé des débarquements provenant de 10 180 ha exploités le long de la côte sud et de 704 ha exploités le long de la côte nord.

On a introduit les contingents en 1979, au moment où l'effort de pêche et les débarquements avaient fortement augmenté et lorsqu'on a commencé à s'inquiéter d'une surexploitation locale possible. Dans le but d'assurer des rendements soutenus et de maintenir une population résiduelle représentant 50% de la biomasse initiale, on a recommandé par la suite le maintien des contingents entre 0,75 et 2% de la biomasse originale.

On a immatriculé deux bateaux en 1984 afin qu'ils transforment leurs propres prises en mer, au nord du cap Caution, où il n'y a pas beaucoup d'usine de transformation et où l'on observe une diminution de la qualité lorsque les coquillages sont transportés aux installations à terre.

Il est nécessaire de faire une évaluation plus poussée des stocks, surtout dans le secteur de la côte nord, et d'étudier les effets de la pêche sur le recrutement.

Mots clés: panopeas du Pacifique, clams, coquillages, Colombie-Britannique, pêche commerciale.

INTRODUCTION

The geoduck clam, Panope abrupta (Conrad, 1849) is the largest subtidal clam in British Columbia. Bernard (1983) reported the change of the former name of Panope generosa (Gould, 1850). Geoduck clams are buried up to a depth of 1.3 m in the substrate (Figure 1 and 2) and are harvested underwater by divers using hand held, high pressure water jets which displace the substrate surrounding individual clams (Figure 3). Geoducks are typically packed into plastic cages measuring approximately $0.5m^3$. A cage usually holds 18 to 21 geoducks and weighs 9 to 21 kg (Figure 4). A review of the B.C. Fishery from its inception in 1976 to 1981 is reported in Harbo and Peacock (1983) and Cox (1979).

Geoducks have been found from the +0.3 m tide level (Anderson, 1971) to -111 m (Jamison et al. 1984); however, only the upper subtidal portion of the stock, at 20 m or less, is exploited due to limitations in fishing technology.

Various aspects of geoduck biology have been investigated in the past 15 years, since geoducks became of commercial interest. Anderson (1971) and Goodwin (1976) describe the spawning and growth of geoducks in Washington; Sloan and Robinson (in press) report on age and gonad development in British Columbia. Age structure, recruitment and growth patterns of various populations are presented in Breen and Shields (1983), Harbo et al. (1983) and Goodwin and Shaul (1984).

Few geoducks less than 12 years of age are currently taken in the fishery (Harbo et al. 1983). They mature at between 4 (Anderson, 1971) and 7 years (Sloan and Robinson, in press). Since the size of geoducks harvested is well above the size at which they mature, most individuals should have an opportunity to breed prior to reaching a harvestable size. Sloan and Robinson (in press) found ripe gonads in clams ranging from 7 to 107 years, suggesting that individuals may be capable of reproducing over a century. Spawning is believed to occur annually.

Harbo et al. (1983) report that the mean ages of geoducks in market samples varied from 28 years at Tofino on the west coast of Vancouver Island to 61 years at Spider Anchorage in the central coast region. The oldest individual found was 146 years old. The mean whole, wet weight of 1,398 clams was 1,065 g while the heaviest individual measured was 2,198 g.

QUOTA MANAGEMENT

Quota management was initially set at a 'conservative' level to give some long-term stability to the fishery and allow for adjustments to be made as knowledge increased. Economic factors, such as marketing, costs of harvesting and competition for the available catch, could also be reviewed.

Quotas were set by groups of Fisheries Management Areas based on stock estimates for the areas. The intent was to manage the fishery in perpetuity, on an annual sustained yield, the quotas to be adjusted as more data became available. Cox (Provincial M.R.B.) and Gould (Federal Fisheries) reviewed the available survey data (Table 1) and revised the standing stock estimates in 1980 (Table 2). Their calculations are not well documented, but their estimates were published by Harbo and Peacock (1983). These differ from estimates published by Cox and Charman (1979).

Initial exploitation rates of 1.2 to 2.5% were suggested by Breen in 1980, based on available biological data from Washington State studies. Later, Breen in Bernard (1982) reported results from additional analysis which recommended an even lower quota. Results suggested that, in order to maintain sustainable yields and a remnant population of 50% of the original biomass, quotas should be kept within 0.75 to 2% of the virgin biomass, depending on the relationship between population size and recruitment. Recent investigations in Washington by Goodwin and Shaul (1984) suggest that fishing may have an adverse effect on recruitment; juvenile geoducks were found in higher concentrations in unfished beds than fished beds. Because of this, quotas should be more conservative, and set at 0.75% of the estimated virgin biomass. The main problem facing managers is the uncertainty in the original stock biomass estimates. In addition, quotas cannot be based on the available biological and stock information alone; other factors such as patterns of fishing and development of the fishery also have to be considered.

In-Season Monitoring of Quotas

Landings at the processing plants are monitored during the season and, as quotas are met, areas are individually closed by Fisheries Public Notices and Notices to Industry. Thus, both fishermen and processors are informed of the closures. The Canadian Coast Guard cooperates by broadcasting notices over the marine channels monitored by the fishing vessels. Due to delays in collecting information from the processors and unpredictable shifts in effort (because of weather, other closures or competition), landings have exceeded most quotas. This is a persistent problem that can only be resolved by a more timely data collection system and increased monitoring of catch and effort on the grounds.

MANAGEMENT, LICENCING AND REGULATIONS

The quota system has changed considerably from year to year, ranging from a single coastwide quota in 1982 to several quotas for management units in other years. Table 3 presents a summary of quotas, landings and management from 1976 to 1984. Harbo and Peacock (1983) discuss the fishery in detail from 1976 to 1981.

In 1981 there were discussions about reducing the quotas in a stepwise manner each year because it was uncertain whether the stock size was great enough to support the fishery at the current level. There was, and still is, confusion over the published estimates (Cox and Charman, 1979) and unpublished and poorly documented analyses by Cox and Gould.

No specific actions were taken on quota licences recommended by the Pearse Commission in 1982.

In 1983, the Category G vessel licence was introduced which allowed the transfer of a licence to a vessel of equal or shorter length. The licences continued to be limited with 54 fishermen being eligible after all licence appeals were heard.

Annual closures have been set over the period from March to mid-April in herring spawning locations on the west coast of Vancouver Island and in the north coast areas 6 to 10. These closures were intended to reduce conflicts with the herring fleet and to avoid disruption of spawning schools and destruction of spawning habitat.

GEODUCK ABUNDANCE AND DISTRIBUTION

In this section, the available information on geoduck abundance and distribution is presented and reviewed.

Tables 1 and 4 present data on geoduck densities from various sources. Almost all of the data on stock abundance in British Columbia has come from surveys carried out by the Provincial Marine Resources Branch (M.R.B.) published in part by Cox and Charman (1979). Much of the data is unpublished so a review of stock assessments is difficult.

Estimates from early M.R.B. surveys (Cox and Charman, 1979) suggest low densities of geoducks in British Columbia of 0.02 to 2.2 t/ha. However, unpublished data from later surveys (1980) in Fisheries Areas 24 and 25 gave densities ranging from 1.6 t to 16.8 t/ha (Table 1). The highest average density was 31.8 t/ha over 38 ha. These later density estimates are considerably higher because only selected, known geoduck beds were surveyed.

Breen and Shields (1983) examined age and size structure in five populations, both fished and unfished, of geoduck clams in British Columbia, and estimated densities from 0.16 to 14.7 geoducks/m^2 (1.7 - 156 t/ha) in several plots of 5 x 6 m. Their densities ranged from 0.60 to 14.73 in unfished plots and 0.03 to 1.8 in

fished plots. In the process of monitoring the fishery, we have surveyed in areas where vessels were actively fishing and measured mean densities ranging from 0.68 to 12.3/m^2 (7.2 - 131 t/ha) (Harbo and Adkins, unpublished) (Table 4).

Goodwin (1978) reports a total of 13,678 ha of geoduck bearing area between 10 and 60 feet deep in Puget Sound, Washington, with an estimated 117,653,000 geoducks. This gives an average density of approximately 9.15 t/ha. Of this area, only approximately 2,023 ha (15%) are considered to be potential commercial geoduck leases (Goodwin, pers. comm.). Density estimates for the geoduck tracts leased annually are 18 to 68 t/ha over beds ranging from 16 to 116 ha.

Jamison et al. (1984) has reported considerable numbers of geoducks in Washington at depths between 18.5 m and 111 m, shown by remote video. On over 6,000 ha of bottom, he estimated a population of 25.8 million geoducks (4.9 t/ha or 0.43/m^2) without any corrections for 'show' factors (Table 4).

The area that has supported commercial fishing in British Columbia, to the end of 1984, is approximately 10,880 ha, as measured planimetrically from the nautical charts submitted by fishermen with their harvest logs (Table 5). This is five times the estimate of commercially harvestable area in Puget Sound which suggests that the potential stock may be underestimated for B.C.

Geoduck Removals by Fishing

The depths of harvest of the cumulative landings from 1978 to 1984 are shown in Table 6. The majority, 67%, of landings have come from the diving depths of 31 to 40 feet (9.2 to 12.2 m). It should be noted that these estimated depths of harvest are reported at different tidal heights with many of the harvest areas having tidal ranges up to 5 m.

In the south coast, over the period 1978 to 1984, there has been an average removal of 1.49 t/ha (0.14 geoducks/m^2) over 10,180 ha (Table 5). Higher removals have occurred on the west coast of Vancouver Island, 3.4 t/ha (0.32 geoducks/m^2) over 2,922 ha than inside waters where 0.71 t/ha (0.07 geoducks/m^2) have been harvested over a reported area of 7,258 ha. Several factors might account for this difference in density removed between the inside and outside of the island. It could be an expression of the actual difference in geoduck density between the sites; it could be due to a difference in fishing intensity such that more effort is spent fishing the west coast than the east coast; or these differences may be a result of errors in estimating the harvested areas from nautical charts.

In the north coast, from 1978 to 1984, only 704 ha of geoduck beds have been identified, with an average cumulative removal of 2.55 t/ha (0.24 geoducks/m^2).

DESCRIPTION OF THE GEODUCK FISHERY 1981 TO 1984

Summaries of geoduck landings in kg and percentage landed by area over the period 1976 to 1984 are given in Tables 7 and 8. Each year is then discussed in detail and data on management, landings and catch per effort are presented. Figures 5a and 5b show the Fisheries Management Areas for the south coast and north coast of British Columbia.

1981 GEODUCK FISHERY

Management Guidelines - 1981

The 1981 fishery was managed by setting quotas for 10 management units in the South Coast, totalling 1,814 t (4 million pounds) and 11 management units in the North Coast, totalling 986 t (2 million pounds). The quotas, landings and closure dates, by management unit, are detailed in Table 9.

Conditions of eligibility for 1981 geoduck and horse clam licences reduced the number of licences from 95 in 1980, to 52 in 1981. Licences for 1981 were restricted to those fishermen who had met the minimum landing requirements of 1979 (including to March 31, 1980), depending on when the fisherman was first licenced.

Geoduck licences were not transferable from one fisherman to another. The licence holder had to be the registered owner of a licenced commercial fishing vessel with a current C licence (or a licence with C privileges). The licence holder could not transfer his geoduck fishing privileges from one vessel to another unless the length of the replacement vessel was equal to, or less than the overall length of the vessel being replaced.

There were some small areas closed to geoduck and horse clam harvesting in 1981 for study or research purposes (Appendix 1). Permits to harvest in areas closed under Schedule I of the Pacific Shellfish Regulations were not issued in 1981. Waters of the Pacific Rim National Park, including the Broken Group Islands, were also closed under the conditions of the licence.

New regulations for geoducks and horse clams were introduced in 1981 in the Pacific Shellfish Regulations to prohibit dumping of geoducks and horse clams (Appendix 2). Regulations were also introduced to limit effort and prohibit night diving when closures were announced.

The South Coast Fishery - 1981

The fishery opened coastwide on January 1, 1981 with an initial concentration of the fleet in Area 24 on the west coast of Vancouver Island and Area 14 on the east coast (Figure 5a). As in

1980, there was a concentration of vessels in given areas and great shifts in effort between areas as a quota was taken and the area closed. Monthly landings by area are shown in Table 10.

The January and February total landings (137 t and 327 t) were twice that of the same period in 1980 and seven times that of 1979. Over the peak six months, February through July, 85% of the total catch was landed. The highest total monthly landing was 500 t in April landed by 36 vessels. The highest monthly landing for any one area was 362 t from Area 24 in May, landed by 24 vessels. The highest previous monthly landing was 293 tonnes from Area 24 in April, 1980 landed by 16 vessels (Harbo and Peacock, 1983).

Most of the coastal landings came from Area 24 (30%) and Area 25 (17.5%) on the west coast of Vancouver Island and Area 14 (6.6%) and Area 17 (5.7%) on the east coast (Table 8). Landings from Area 23 and 26 decreased in 1981, while landings in Area 25 increased.

Closures in areas of traditional herring spawn deposition were introduced in 1981 in Areas 23, 24 and 25 over the period March 1 to mid April. Fishing continued in surrounding sub-areas so that area quotas were taken by early April (Table 9).

The North Coast Fishery - 1981

Twenty-one vessels reported landings from the north coast region in 1981, an increase from seven vessels in 1980. Landings increased from 2.3% to 18.7% of the total coastwide landings. Some very high daily vessel catches were reported, up to 5,800 kg landed by as many as six divers.

Monthly geoduck landings by Statistical Area are shown in Table 10. The north coast fishery began in June, with the highest landings in June (200 t) and July (205 t), and continued until November.

Geoducks were landed by groups of vessels that chartered a packer vessel to deliver the product from the fishing grounds to Port Hardy, where they were picked up by truck and delivered to various processing plants. The packers carried 13 to 23 t (approximately 700 to 1,000 cages) of clams per trip. This transportation of the live geoducks took 2 to 3 days, at best, and in some cases longer so that some loads were 'spoiled' in transit and had to be destroyed. These losses are not included in the reported landings.

The north coast quota of 907 t (2 million lb.) was initially divided among 11 management units subject to review and adjustment in-season as the landings were monitored (Table 9). In response to requests by the fishermen, quotas were combined to make it economically feasible to fish and deliver the geoducks to the processors. It was unrealistic to fish many small quotas in areas all over the north coast. Quotas for Areas 6, 7 and 8 were combined and increased for a quota of 295 t and Area 9 and 10 were combined for 136 t. A closure was initiated in Areas 6 to 10, from

March 1 to April 30 for the protection of herring spawning grounds. Fishing began in June and Areas 6, 7 and 8 closed July 31, 1981 when the quota had been overrun, with combined landings of 405 t. To promote exploration and to prove new grounds, an extension for Area 7 was granted October 15 with an additional quota of 22.7 t. The area was in the waters north of a line from Currie Islet light to Soulsby Point on Campbell Island then due east to the boundary between Area 7 and 8, excluding the areas previously harvested. Although new grounds were located, only 2.9 t were reported in November, 1981.

Surveys in Area 7 in July, 1981 (Harbo and Adkins, unpublished) found very high densities of geoducks, up to 36/m^2. (Table 4).

1982 GEODUCK FISHERY

Management Guidelines - 1982

The initial 1982 fishery management plan was to manage by quotas totalling 2,023 t set for 10 management units in the south coast and 907 t in 11 management areas in the north coast. However, due to delays in changes in shellfish regulations and the new Pacific Fishery Management Area Regulations, industry was advised in April, 1982 that the 1982 geoduck season would close on a coast wide basis when landings reached 2,930 t. All areas remained open until the coast-wide quota was reached, September 1, 1982 (Table 3).

In 1982, the number of eligible licence holders was 57, the increase from 52 being due to successful licence appeals. The licencing guidelines were the same in 1982 as in 1981, i.e. the licence holder had to be a registered owner of a licenced commercial fishing vessel with a current C licence (or a licence with C privileges), licences were not transferable from one fisherman to another, and a licence holder could not transfer his geoduck fishing privileges to another vessel greater in length. There were no new area closures for study or research purposes in 1982.

By 1982, all processors had developed markets for the geoduck body meat. However, two problems persisted in 1982 resulting in large (but unestimated) waste and dumping of geoducks. The first problem was one of organization and logistics; geoducks were often left on wharves for several days before being picked up and were spoiled by the time they reached the processing plant. Delays in pick-up by packers on the grounds in the central and north coast and at Port Hardy by the trucks resulted in the dumping of several loads of geoducks. A typical packer load was 13 to 23 t.

In April and May of 1982, numerous fishermen complained that several processors had initiated a grading system and paid less for dark geoducks or, in some cases, they did not pay at all. This resulted in loss of income and numerous reported incidents of dumping of clams on the grounds and at the plants. Some processors complained that fishermen would not move from areas where there

were high percentages of dark geoducks. The processors reported difficulties in marketing the geoducks in Japan, particularly the less desirable dark neck meats. This is discussed in greater detail in the section Geoduck Grades and Prices.

A meeting was held with processors in May, and in June there was a 9-day, coast-wide closure to allow for a meeting with the fishermen to review and discuss marketing problems, quotas, regulations and the illegal dumping of geoducks. The fishermen were committed to reduce and eliminate dumping and waste.

In September of 1982, the final report of the Commission of Pacific Fisheries Policy, Peter H. Pearse, Commissioner, was issued. The report recommended a vessel quota and area licencing system (Appendix 3).

While many of Pearse's recommendations for other fisheries were implemented, commercial fishermen rejected the concept of 10-year quota licences for geoducks or other species. Other options are still under consideration.

The South Coast Fishery - 1982

Because the quota was not distributed among areas, much of the fleet concentrated their efforts on the west coast of Vancouver Island in Areas 24, 25 and 26 where the combination of geoduck density and harvesting efficiency is greatest. Although geoduck densities are higher in the central and north coasts, the lack of support facilities limits the practicality of working there. South coast landings accounted for 92% of the total, with 73% coming from Areas 24, 25 and 26 (Table 8).

The highest total monthly landing for the coast was 800 t in April, landed from 40 vessels in 11 statistical areas. The highest monthly landing from any one Area was 260 t from 14 vessels in Area 26 in April (Table 11).

Closures for the protection of herring spawning grounds ran from February 25 to March 31 in Area 24 and to April 15 in Area 23.

The North Coast Fishery - 1982

Costs and logistics of packing geoducks from the grounds to Port Hardy, and then trucking them to the processing plants limited the north coast fishery in an open coast-wide quota system. The high densities of geoducks and high catch per unit effort in Area 7 attracted 10 vessels only. Five vessels reported 227 t over the period April to July, fishing 81 days for approximately 9% of the coastal landings (Tables 8 and 11).

(**NOTE**: Harvest logs showed 10 vessels landing 340 t over 212 vessel days)

1983 GEODUCK FISHERY

Management Guidelines - 1983

The 1983 fishery was managed by setting quotas for two management units in the South Coast totalling 2,041 t and three management units in the North Coast totalling 907 t. The quotas, landings and closures dates are detailed in Table 12.

The return to quotas by management units resulted from the introduction of the Pacific Fishery Management Area Regulations in 1983.

The vessel G Licence came into effect in 1983 with new sections introduced to the Pacific Fishery Registration and Licencing Regulations (Appendix 4).

The South Coast Fishery - 1983

Quotas were set for two management units only in the South Coast: 453.5 t on the east coast of Vancouver Island,Areas 12 to 19, and 1,587 for the west coast of Vancouver Island, Areas 20 to 27 (Table 12). This action was based on assurances from fishermen that they would distribute their effort without specific area quotas.

The fishery had a slow start in 1983 due to poor marketing conditions. Only 252 t had been landed by the end of March, 1983 (Table 13) compared to 852 t over the same period in 1982 (Table 11). Many of the processors paid different prices according to the grade (white-bright being the most desirable) and reports of dumping dark geoducks persisted in early 1983.

The quota for the west coast, Areas 20 to 27 was taken and the areas closed on July 16, 1983. Contrary to expectations, the fleet concentrated in Tofino, Area 24, where it landed 1,067 t or 64% of the west coast total. As in 1982, this was due to the services available in Tofino and good roads for the pick-up of clams by truck.

On the east coast of Vancouver Island, the fishery centered around Area 13, 14 and 15 (Table 13). Data to monitor the quota for Areas 12 to 19 was not available at year end and these areas remained open with a quota overrun of 115 t. This allowed for a year-round, continuous supply to develop live and fresh markets.

The North Coast Fishery - 1983

The north coast quotas were redistributed to maintain a policy of a 2 million lb. (907 t) quota until harvest areas were identified that could support a larger quota on a sustained yield basis. The north coast fishery was again limited due to logistical problems of working in remote areas and the time and costs involved in transporting the clams to processors in the south.

Landings of 501 t were reported from Area 7 and 8 only, over the period July to October 15, 1983 (Table 13). The quota of 453.5 t was overrun due to poor performance by the processors in providing landing data and submitting sales slips. Although quotas were set for other north coast areas, 159 t in Areas 3 to 5 and 295 t in Areas 1, 2E and 2W, no fishing took place.

1984 GEODUCK FISHERY

Management Guidelines - 1984

The fishery was managed by a north coast quota of 907.2 t for 4 management units and a south coast quota of 2,086.5 t for 12 management units (Table 14). Areas 1 and 2W in the Queen Charlotte Islands remained open year round to encourage exploratory fishing. Similarly, Areas 11, 12 and 20 in the south coast were open with no quota.

The eligible licences remained at 54, but the number of vessels that actually fished dropped to 44, the smallest fleet since 1978 (Table 3).

The South Coast Fishery - 1984

The landings from the east cost of Vancouver Island contributed a much higher percentage to the total landings than it had in the previous three years, since 1980. The east coast contribution has dropped steadily from 100% in 1976 to 18% in 1983, but in 1984, it rose to 34% (Table 8), largely due to increased effort in Areas 12 and 13 where the fishing was less restricted, and Areas 17 and 19. This shift was due to an increased quota (Table 14) and interest in clams for live markets that require small volumes, but a consistent year-round supply. The fishing effort in the west coast remained as high as in previous years, with the result of higher overall landings in 1984.

The west coast quotas were taken, and all areas closed by the end of July (Table 14). Fishing continued on the east coast in Areas 14 to 19 until the end of August and then in unfished subareas of 11, 12 and 13 until December 31 to maintain small volumes for live markets.

Closure of areas for the protection of spawning herring was in effect from mid February to mid April in parts of Area 23, 24 and 25.

North Coast Fishery - 1984

The quota of 907 t remained unchanged in the north coast. Landings were somewhat higher than previous years (Table 7); a total of 575 were reported from seven areas (Table 15) by 20 vessels.

Two vessels were issued "P" licences to process their own geoduck landings, north of Cape Caution. This is described in detail under the section "Processing of Geoducks at Sea".

SUMMARIES OF SOME CATCH AND EFFORT STATISTICS - 1981 to 1984

The data presented in this section are reported landings from sales slips and, in some cases, harvest logs, where more detailed information is provided. Catch statistics are incomplete because of unreported quantities of dark geoducks that were dumped and several loads of geoducks that spoiled due to delays in pick-up and processing. Data from 1976 to 1980 were reported by Harbo and Peacock (1983).

SEASONAL LANDINGS

Harvest rates have been dictated by seasonal and market conditions. The fishery has opened on January 1 each year, although only 5 to 17% of the landings have been taken in the first two months because of poor geoduck shows and winter storms. Most of the landings, 61 to 82%, have been taken from March to July (Tables 10, 11, 13 and 15). The north coast fishery usually begins a month or two later than the south coast.

SIZE OF VESSELS IN THE FISHERY

The geoduck fishery has been conducted from small vessels; 7.18 to 15.21 m (23.5 to 50 feet). A policy was introduced in 1980 which limited the transfer of geoduck licences to a vessel of equal or smaller size (length). The policy was put into regulation with the introduction of the category G vessel licence (Appendix 4). Figure 6 shows the size of vessels active in the fishery in 1984. In 1984 only 9 of 44 active vessels were greater than 12.1 m (40 ft.) in length.

THE NUMBER OF VESSELS ACTIVE IN THE FISHERY (1979 TO 1984)

Prior to licence limitation in 1979, a number of licences were inactive (Table 3), and some were being held on a speculative basis, on the assumption that they could be sold for a high value when the licences were limited. A minimum landing requirement reduced the fleet in 1980 to those vessels with some active participation in the fishery (Harbo and Peacock, 1983).

An analysis of the fishing days and annual landings for each vessel shows that from 1981 to 1983 many eligible vessels were either inactive or had minor contributions to the overall effort and landings (Figures 7 and 8). In 1984, fewer vessels reported sales and the active vessels had greater effort and landings.

VESSEL FISHING DAYS

The distribution of vessel effort from 1981 to 1984 is shown in Figure 7. The number of vessels with high efforts, greater than 100 days, increased over the period 1981 to 1984. The mean number of fishing days of active vessels increase each year to 69 days in 1984. Many of the boats with low efforts prior to 1980 (less than 30 days) did not meet minimum landing requirements to qualify for a geoduck and horse clam licence in 1981. There were no further landing requirements after this reduction of the fleet.

VESSEL LANDINGS - DISTRIBUTION OF CATCH

The distribution of the annual geoduck harvest by individual vessels for the period 1981 to 1984 is shown in Figure 8. From 1981 to 1983 a significant portion of the fleet (28% to 37%) landed only 0 to 20 tonnes. This proportion decreased to only 9% in 1984.

The number of vessels that landed greater than 100 t increased from 9 vessels in 1981 to 14 vessels in 1984. For each year, these landings represented approximately 50% of the total catch. The mean catch per vessel increased each year to 79 t/vessel in 1984.

VESSEL CATCH PER UNIT EFFORT (CPUE) - DAILY LANDINGS

The daily landings of a vessel depends on many factors, including the number of divers, working depths, concentrations of geoducks, water conditions (clarity, currents) and the substrate type (sand, gravel, shell, mud). Most vessels have one or two hoses with two to four divers per day.

Figure 9 illustrates the average daily landings (kg/day) of all vessels over the season. Vessels landed a seasonal average of 1 t to 1.2 t/vessel day. A few vessels reporting average landings of up to and exceeding 3 t/vessel day in the north coast where efforts appear higher due to fewer days of fishing, fishing at times of best shows, and in many cases, having more divers per day.

DIVER CATCH PER UNIT EFFORT

Figure 10 illustrates mean diver catch per unit effort over a season as reported on harvest logs from 1978 to 1984.

A geoduck diver averages approximately 2 clams per minute or 125 kg/hour in an average day of 200 diving minutes (3.3 hours). Divers with the highest landings (top 10 divers) fished from 263 to 492 hours in a season. The overall catch per unit effort has increased from 1978 to 1984, a trend most likely due to improved diver experience in both harvesting and the site selection. The decline in CPUE in 1983 is considered to be a consequence of

grading and difficulties in finding areas with high percentages of the more desired grades 1 and 2. (See Geoduck Quality and Grading).

The distribution of diver catch per unit effort from 1981 to 1984 is shown in Figure 11. The majority of divers land between 1.5 and 3.0 kg per minute, but the CPUE can be as high as 4 to 5.5 kg or 4 to 5 geoducks per minute.

Divers are usually paid 40 to 50 percent of the landed value, calculated by the number of geoducks they harvest multiplied by an average weight as determined from the sales slip. Geoduck diving is an extremely demanding job, requiring many hours of diving under adverse conditions of cold water, heavy gear, currents and poor visibility.

Although a few divers have been in the fishery since its beginning, most divers stay in the fishery for only three or four years, and there is generally a large turnover each year. The harvest log records show 192 divers in 1981: 84 new divers, 104 divers that fished in 1980, 72 fished in 1979 and 27 fished in 1978. In 1982, there were records for 195 divers; 77 were new divers, 98 fished in 1981, 81 fished in 1980, 60 fished in 1979 and 19 fished in 1978. There were a total of 146 divers in 1983; 38 new, 90 fished in 1982, 59 fished in 1981, 50 in 1980, 43 in 1979 and 14 fished in 1978. In 1984, there were 150 divers; 60 new, 69 fished in 1983, 60 fished in 1982, 42 in 1981, 45 in 1980, 31 in 1979 and 11 fished in 1978.

GEODUCK CATCH BY DEPTH

Geoducks occur from the low tide zone (0.3 m) to depths of 111 m (Jamison et al. 1984). Table 6 shows the percentage of the annual catch taken from different depths. The highest percentage of landings, 65% over the period 1978 to 1984, has come from diving depths of 9.2 to 12.2 m (31 to 40 ft).

Fishermen have reported fishing to depths of 60 to 70 feet (18 to 21 m) and there is lately some tendency to fish slightly deeper (pers. comm., Table 6). This doesn't necessarily indicate that all the shallow stocks are depleted; there are economic reasons for fishing a particular bed deeper while shallower stocks still exist elsewhere. It is often to the operators advantage to remain in an area where facilities are good, fuel costs are less and the grounds are protected from the weather, and work deeper, than to lose time and risk the loss of production while exploring new territory for virgin geoduck beds. Areas are opened to all vessels on a competitive system until the quota is taken, and lost days likely mean a loss of a share of the area quota. To maintain high catch rates, as reflected in the previous section, fishermen must either fish new beds or extensions of old beds into deeper water at lower tidal heights (tidal ranges of 15 feet are not uncommon). When there are two divers in the water, one may fish shallow while the other fishes in deeper water.

GEODUCK WEIGHTS AND WATER LOSS

We found a mean weight of 1065 g (2.3 lb.) from measuring 1,398 clams at the processing plants, with individual weights ranging from 94 to 2198 g (Harbo et al. 1983).

Goodwin (1976) found that for Puget Sound geoducks, the greatest annual weight gain occurred between the third and seventh years and that an average 10 year old geoduck weighs 1200 g.

Anderson (1971) estimated that the whole fresh animal contains approximately 28.1% water/sand, 17.4% shell, 12% viscera and 42.5% edible meat. Goodwin (1973) reported that the average whole, fresh dug geoduck consists of about 56% meat, but he defined meat as all portions of the clam, minus the shell and water of the major body cavities. Goodwin (1978) allowing 2 to 10 minutes before weighing, found that the mantle 'steak' (body meat, brisket or belly) comprised approximately 15 to 18% of the whole wet weight while the siphon or 'neck' comprised approximately 20 to 25% of the whole wet weight. We have found that neck meat comprises 25% of whole wet weight and neck plus body meat comprises 43% of whole wet weight.

There are several problems with examining weights of geoducks reported on sales slips because of the varying procedures. Weights on sales slips are not always 'true weights' as they sometimes have a percentage (often from 10 to 20 percent) deducted for water content. The delivery time for geoducks may be one to three days after harvest, and the water loss varies considerably.

FISH INSPECTION AND PRODUCT QUALITY

PROCESSING REQUIREMENTS

Geoducks are processed in federally registered shellfish plants and are monitored by the Fish Inspection Division, Field Services Branch of the Department of Fisheries and Oceans. A schematic diagram of the steps involved in the processing of geoducks is shown in Figure 12. Full processing includes an initial blanching by steam then removal of the shells, separation of the skin from the siphon, and the cutting of the viscera and gills from the body meat and siphon. The siphons are further scrubbed and rinsed prior to grading. The final products are weighed and frozen in plastic bags. Given the overwhelming preference in Japan for white or light coloured siphons, marketing of the body meat and the darker siphons becomes a problem for some processors. To prevent the waste of natural resources, regulations were introduced in 1981 to prohibit the dumping of body meat or the dark coloured geoducks.

In recent years, live geoducks have gained recognition in sushi bars and seafood restaurants in British Columbia and other major cities in North America. The distinctive clam nectar aroma makes an ideal soup base for clam chowders.

Often, the geoducks destined for the live or fresh market are selected out first and the remaining clams are processed. Geoducks are almost always processed fresh as freezing prior to processing results in a poor texture.

PROCESSING OF GEODUCKS AT SEA - Vessel "P" Licences

In 1984, two "G" licence vessels were licenced to process their own catch at sea, north of Cape Caution where processing facilities are limited and a loss in quality occurs in transporting the clams to shore based plants. Processing at sea was limited to processing geoducks into fresh or frozen necks and body meat. The product had to be delivered to and stored at a federally registered plant for grading, final processing and inspection for wholesomeness.

The construction and operation of the processing facilities must comply with the Federal Fish Inspection Regulations. These include a sterilized (ultra-violet) bacteriologically safe supply of hot and cold water, approved construction materials, adequate lighting, double compartment sink, sloped floor for adequate drainage, and washable walls, floor and ceiling.

The "P" licence required an accurate inventory system so that all lots are date coded and labelled on the packages and containers to indicate the catch location.

Offal and waste must be dumped away from harbour areas and in waters with good tidal action over twenty metres deep.

A fish processing licence is also required from the Provincial Government of B.C.

GEODUCK QUALITY AND GRADING

Yamamoto, Cox and McIlwaine prepared a report (1978) on "Research and Development Activities in the Processing of Geoducks". In 1983, Griffiths (unpublished) prepared a preliminary report and review on final product grade standards for geoduck clam siphons.

All processors grade geoduck clams and may pay different prices for the various grades. Grades are based on freshness, colour and condition of the siphons (i.e. presence of marks or pustules), the length of the siphon and the percentage of body meat at the siphon-body cut.

Most processors utilize four grades; siphons that are white and measure greater than 15 cm are graded #1 and #2 are used for the sushi market. The percentage of body meat/siphon at the cross sectional siphon/body cut should not exceed 50%. Darker or blemished siphons, graded #3 or #4, are processed further or directed to markets where colour is not a critical factor.

Preliminary results from our quality studies (unpublished) indicate that siphon colour is related to age; white geoducks were significantly younger than dark geoducks. Further studies are required to examine if grade is related to the harvest location, substrate, physical exposure or other factors.

PARALYTIC SHELLFISH POISON (PSP) IN GEODUCKS

The source of paralytic shellfish poison (PSP) is a microscopic single-celled plankton called Protogonyaulax catenalla or P. acatenella. This organism contains a neuro-toxin which inhibits the transmission of nerve impulses in the human nervous system. Death from asphyxiation due to respiratory paralysis has resulted when bivalves containing high concentrations of toxic Protogonyaulax were consumed. So far there are no recorded PSP cases from the consumption of geoduck clams.

Geoduck clams, being filter feeders like other clams, oysters and mussels, will injest and accumulate bacterial and Protogonyaulax organisms in their bodies. The maximum allowable limit of PSP toxin is 80 µg/100g of shellfish meat. In 1977, PSP levels of up to 2700 µg/100g of meat were detected in geoduck samples from Hayden Passage in Area 24 (Figure 5a). A subsequent survey in 1979 confirmed earlier findings that PSP toxins in geoducks are concentrated in the gut and not in the edible meat. In February, 1982, geoducks from Toquart Bay (Area 23) were dissected for PSP analysis. The results showed that PSP levels as high as 1100 µg/100g were found in the gills. With the removal of the gills and the viscera (gut) during processing, the potential danger of consuming toxic geoduck is reduced. Accordingly, the harvesting of geoducks from PSP closed areas is allowed under the terms of the geoduck licence. For live shipments of geoducks from PSP closed areas, the companies are required to make prior arrangements with the Fish Inspection Division for the testing and clearance.

SANITARY CLOSURES

Bacterial contamination from raw sewage discharges, leaking septic tanks and agricultural landwash have resulted in the closure of some coastal areas to shellfish harvesting.

The closure applies to all bivalve molluscs, including geoducks, found within the closure boundary. Because of the risk of introducing contamination to the processing plants and the minimal availability of geoducks in the intertidal areas, no harvest permits have been issued for closed areas during the last several years.

MARKET AND ECONOMIC CONSIDERATIONS

LANDED VALUES

The quantities and value of geoducks landed from 1977 to 1984 (Table 16) fluctuated according to the markets and restraints imposed by quotas and management.

In 1982, there were difficulties in marketing darker and poorer grades of geoducks, resulting in the waste and dumping of many clams that were not recorded in the landings. The mean price of geoducks, according to reported landings on sales slips, increased to $0.40/lb. or $0.89/kg.

In 1983, however, the mean price of geoducks dropped drastically to levels of 1979; $0.31/lb. or $0.68/kg. Mean prices recovered in 1984 to $0.38/ lb. or $0.84/ kg.

GEODUCK GRADES AND PRICES

The processors grade geoducks, as discussed in the previous section, and most pay different prices according to the quality of the product. In 1983, 14% of the landings were bought at $0 to $0.25/lb ($0 to $0.55/kg); some of the poorer grades were taken on speculation only, with payment if, or when, the processor could market them. The majority of landings, 86%, were bought at $0.30 to $0.70/lb ($0.66 to $1.54/kg). In 1984, only 4% of the catch was reported at $0.25/lb or less while 96% were bought at prices between $0.30 and $1.00/lb (0.66 to $2.20/kg).

GEODUCK EXPORTS

More than 90% of the geoducks landed are exported as various products, which include frozen neck meat, frozen body meat, fresh shucked meat, whole frozen or live/fresh, as summarized in Table 17.

Average recovery rates are 30 to 45% edible meat from the whole fresh animal; neck meat comprises 20 to 25% and body meat 10 to 20% according to the cuts and trims by the individual processors (data from records provided by British Columbia geoduck processors).

The exports by product types and country for the years 1981 to 1984 are detailed in Tables 18 to 21. Export data for 1981 and 1982 are obviously incomplete when compared to the B.C. production statistics. The major export product (50% to 60% by quantity, 80% to 90% by value) is the neck meat, which is exported primarily to Japan. The major market for the body meat and the live/fresh product is the United States. They accounted for 25% of the total live/fresh exports in 1984.

Prior to 1981, live geoducks were exported by truck to Washington for processing. Regulations were introduced in 1981 that required processing in Canada, unless the geoducks were exported by air carrier for the live market (Appendix 5).

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Table 1 - Summary of estimates of geoduck clam stocks from surveys carried out by the Provincial Marine Resources Branch

Statistical Area	Survey Area (ha)	Stock Density (tonnes/ha)	Standing Stock Estimate (tonnes)	Standing Stock Estimate lb.(x1000)
East Coast Vancouver Island				
12[1]	11,414	0.12	1,423	3,138
13[1]	5,988	0.37	2,197	4,844
14[1]	7,317	1.01	7,395	16,306
15[1]	1,375	0.15	212	467
16[1]	2,349	0.74	1,738	3,833
17[1]	3,265	2.19	7,141	15,745
18[2]	891 (144.3)	0.02 (6.13)	15 (884.3)	34 (1,950)
19[3]	5,575	0.49	2,762	6,091
20[3]	1,361	0.56	763	1,683
	39,535 ha		23,646 tonnes	52,141 (x 1000) lb.
West Coast Vancouver Island				
23[4]	3,368 (6,021)	3.26 (2.73)	10,984 (16,460)	24,215 (36,288)
24[5]	21,180	1.61	34,074	75,120
25[6]	1,036	16.8	17,315	27,329
	25,584 ha		62,373 tonnes	126,664 (x 1000) lb.
North Coast[7]				
1	32,560	0.19	6,130	13,514
2E	250,009	0.06	14,349	31,634
3	3,341	1.22	4,069	8,968
4	7,143	0.92	6,554	14,449
5	4,648	0.63	2,936	6,473
	297,701 ha		34,037 tonnes	75,038 (x 1000) lb.

[1] Published data, Cox and Charman (1979).

[2] Area 18 was surveyed in 1977 and an estimate was published by Cox and Charman (1979). A later survey in 1978 identified additional stocks (shown in brackets, unpublished data).

[3] Areas 19 and 20 were surveyed in 1978, (unpublished data).

[4] Area 23 was surveyed in 1978 (unpublished data). The total area and stock estimates are given in ( ). This estimate was reduced to exclude areas and populations in the Broken Group, Pacific Rim National Park (unpublished data).

[5] Area 24 estimate is based on surveys in 1978; some areas were resurveyed in June-July, 1980, but the raw data were not combined for a new estimate (unpublished data).

[6] Area 25 - only a few selected known beds were surveyed, resulting in high densities over a small survey area (unpublished data).

[7] North coast areas were surveyed in August and September, 1978 (unpublished data).

Table 2 - Adjusted geoduck standing stock estimates[1] (1980) for quota purposes.

Fisheries Management Areas	Geoducks (metric tonnes)	Geoducks (lb.)
Areas 11, 12	181	400,000
Area 13	1,377	3,036,000
Area 14	9,081	20,020,000
Area 15	1,194	2,633,000
Area 16	2,764	6,093,000
Areas 17, 18	9,516	20,978,000
Area 19	2,734	6,207,000
Areas 20 and 23	15,848	34,938,000
Area 24	38,488	84,850,000
Areas 25, 26, 27[2]	34,020	75,000,000
	115,203 t	254,155,000 lb.

[1]Interpretation of estimates by the Provincial Marine Resources Branch (Cox and Charman, 1979 and Cox, unpublished data) by Cox and Gould, 1980, unpublished.

[2]Based on expectation of stocks similar to other areas on the west coast of Vancouver Island.

Table 3 - Summary of quotas, landings and management from 1976 to 1984.

Year	Management Units Statistical Areas	Quota (tonnes)	Reported Landings[1] (tonnes)	Management	# of eligible licences	# of vessels with landings[2]
1976	South Coast, Strait of Georgia	No quotas	44	Five operators harvested in designated areas in the Strait of Georgia	7	5
1977	Coastwide opening	No quotas	245	All landings from south coast - Strait of Georgia and Tofino region, Area 24	30	14
1978	Coastwide opening	No quotas	1,016	Licences issued pursuant to Pacific Shellfish Regulations - mechanical harvesting	54	27
1979	North Coast - 1 management unit South Coast - 1 management unit	1,587 2,041	0 2,463	Because of increase in effort and landings, licence limitation and quotas were introduced. South coast Areas 13 - 19 and 24 were closed Sept. 20, 1979. Other areas in Strait of Georgia and west coast Vancouver Island open to December 31.	101	72
1980	North Coast - 4 management units South Coast - 8 management units	1,587 2,041	68 2,723	Licences limited. South coast areas closed by August 31. First landings from north coast fishery.	95	63
1981	North Coast - 11 management units South Coast - 10 management units	986 1,814	508 2,195	Effected minimum previous landing criteria of 13.6 t in 1978 or 1979 for licence eligibility Closure of areas on west coast Vancouver Island during herring season. Quotas reduced because of stock uncertainties.	52	49
1982	Coastwide opening	2,930	3,134	With whole coast open, majority of landings came from south coast. Coast closure on September 1, 1982. Pearse commission recommended a quota and area licencing system.	57	53
1983	North Coast - 3 management units South Coast - 2 management units	907 2,041	502 2,239	Some areas open to December 31. Return to management units. Introduction of vessel G licence, transferable to a vessel of equal or shorter length. Grading introduced by processors.	54	53
1984	North Coast - 3 management units South Coast - 10 management units	907 2,086	574 2,908	Catch and effort increased. Exploratory areas opened in winter to maintain year round fishery. Vessel processing licenced.	54	44

[1]Reported landings from sales slip submissions.
[2]Some licences were transferred to other vessels or vessels were replaced so that more than one vessel may have reported landings on the same licence.

Table 4 - Geoduck Densities from Various Sources*

Source	Location	Survey Area	Density - geoducks/m^2 x±S.D.	Density - geoducks/m^2 Range
Anderson (1971)	Puget Sound, Washington[1] (Intertidal)	7 plots of 1000 ft^2 = 0.65 ha	0.13	0.02 to 0.28
Goodwin (1978)	Puget Sound, Washington[2]	13,678 ha	0.86g/m^2	
Goodwin (1984 pers. comm)	Puget Sound - Potential Lease Area Estimate[1]	2,023 ha	-	1.6 to 6.4
Breen and Shields (1983)	Brady's Beach, Bamfield (Area 23), B.C.[1]	60m^2	14.73	
	Sibell Bay, Ladysmith (Area 17), B.C.[1]	90m^2	1.36 ± 0.62	0.6 to 2.2
	Elbow Bank, Tofino (Area 24), B.C.[2]	120m^2	1.46 ± 0.17	0.9 to 1.8
	James Island (Area 19), B.C.[2]	120m^2	0.59 ± 0.03	0.5 to 0.8
	Comox (Area 14), B.C.[2]	120m^2	0.16 ± 0.02	0.03 to 0.3
Harbo and Adkins (unpublished)	Breadner Group, Spider Anchorage, B.C.[2] (Area 7) - July, 1981	40m^2	10.83 ± 9.03	0 to 36
		17m^2	4.35 ± 3.16	1 to 11
		25m^2	9.16 ± 5.71	2 to 22
		25m^2	12.32 ± 3.83	4 to 23
	Kyuquot[2] (Area 26), B.C. - 1982	25m^2	2.72 ± 1.70	0 to 7
		16m^2	1.50 ± 1.15	0 to 3
		5m^2	2.6 ± 1.14	0 to 4
		50m^2	3.52 ± 1.91	0 to 8
		50m^2	1.7 ± 1.23	0 to 5
		50m^2	7.76 ± 3.58	2 to 17
		25m^2	0.68 ± 0.95	0 to 3
		37m^2	1.16 ± 1.12	0 to 4
	Tofino-Lemmens Inlet, B.C.[2] (Area 24) - 1982	30m^2	1.5 ± 1.2	0 to 5
	Rolling Roadstead (Area 25) - 1984	30m^2	11.77 ± 4.9	6 to 19
		25m^2	0.92 ± 0.91	0 to 3
		50m^2	0.86 ± 1.01	0 to 4
	Tofino - Area 24[2]	6.3 ha	4.86	0 to 13
Jamison et al. (1984)	Case Inlet, Puget Sound[2]	1.85 ha	0.43	

*The survey methods varied, so the density estimates may not be comparable.
Conversions: geoducks/m^2 = 10.65 t/ha.
[1]Virgin geoduck beds.
[2]Geoduck beds that have been fished.

Table 5 - Geoduck harvest areas and removals as reported on harvest logs, 1978 to 1984.

Area	Reported Harvest Area ha	Number of Beds	Range in Size of Beds ha	Density of Geoducks Removed t/ha	Density of Geoducks Removed #/m^2
Inside of Vancouver Island (Areas 12 to 19)	7,258	143	3 - 631	0.71	0.07
West Coast Vancouver Island (Areas 20 to 27)	2,922	93	2 - 265	3.40	0.32
[1] South Coast (Areas 12 to 27)	10,180	236	2 - 631	1.49	0.14
[2] North Coast (Areas 1 to 9)	704	33	2 - 140	2.55	0.24

Conversion 1 geoduck/m^2 = 10.65 t/ha @ average weight of 1.065 kg per geoduck (Harbo, et al, 1983).

Table 6 - Geoduck harvest by depth interval for the years 1978 to 1984, in percentage of the annual harvest.

Depth Interval (ft)	Percentage of annual harvest at depth intervals							
	1978	1979	1980	1981	1982	1983	1984	1978-1984 Combined
10 - 20	0.1	1.2	0.7	1.3	1.7	0.4	1.5	1.2
20 - 30	50.6	20.6	18.0	12.2	16.3	8.9	21.8	18.4
30 - 40	32.1	67.7	69.1	69.5	63.6	79.0	53.8	65.0
40 - 50	16.2	10.2	11.9	11.9	18.2	10.4	20.9	14.6
50 - 60	0.3	0.2	0.3	0.6	0.9	0.1	1.9	0.6
60 - 70	0	0	0.1	.1	0	0	tr	tr

Table 7 – Summary of geoduck landings by area (tonnes) as reported on sales slips, 1976 to 1984.

	NORTH COAST										SOUTH COAST															Annual Landings (t)
											Mainland And East Coast Vancouver Island									West Coast Vancouver Island							
Year	2E	3X	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	23	24	25	26	27	
1976													9.5			8.2		26								44
1977												14	9.2	77		137	1.7				6.0					245
1978												8.4	261	321	3.4	24	19	136	0.5	2.7	1.8	236	2.0			1016
1979											24	160	276	263	148	209	2.9	159			153	950	87	22	9.4	2463
1980	31		3.6					28	5.3			97	210	17	298	221	34	91	5.1		288	841	321	303		2794
1981	11			84	6.1	370	18		20			41	180	29	70	155	44	28	7.6		187	819	473	156	5.7	2704
1982						227					83	14	144	33	103	17	1.0	14	14		174	1218	366	726		3134
1983						202	299				16	29	340	29	42	13	2.0	9.8			84	1066	215	287	0.9	2536
1984	3.6	3.4	-	213.7	7.9	108.9	182.6	53.8	-	8.3	301.7	149.7	284.8	53.7	129.2	128.3	0.5	117.8	-	-	218.9	627.8	442.1	443.2	2.0	3482
1976 – 1984	46	3	4	298	14	908	500	82	25	8	425	513	1715	823	793	912	105	582	27	3	1113	5758	1906	1937	18	18518

East Coast Vancouver Island = 5,876

West Coast Vancouver Island = 10,762

North Coast Total = 1,880 tonnes

South Coast Totals = 16,638 tonnes

COASTWIDE LANDINGS = 18,518 tonnes

Table 8 - Summary of the percentage of geoduck landings by area as reported on sales slips, 1976 to 1984.

	NORTH COAST										SOUTH COAST																	
										North Coast Sub	East Coast Vancouver Island									East Coast Sub	West Coast Vancouver Island							West Coast Sub	South Coast Sub
Year	2E	3X	4	5	6	7	8	9	10	Total	11	12	13	14	15	16	17	18	19	Total	20	21	23	24	25	26	27	Total	Total
1976														21.7			18.8		59.5										100
1977													5.7	3.7	31.4		55.9	0.7		97.4				2.4				2.4	100
1978													0.8	25.7	31.7	0.4	2.3	1.8	13.3	76.1	0.1	0.3	0.2	23.2	0.2			23.9	100
1979												1.0	6.5	11.2	10.7	6.0	8.5	0.1	6.5	50.4			6.2	38.6	3.5	0.9	0.4	49.6	100
1980	1.1		0.1					1.0	0.2	2.3			3.5	7.7	0.6	10.7	8.0	1.2	3.3	34.7	0.2		10.3	29.9	11.5	10.8		63.0	97
1981	0.4			3.1	0.2	13.7	0.6		0.7	18.7			1.5	6.6	1.1	2.6	5.7	1.6	1.0	20.1	0.3		6.9	30.3	17.5	5.7	0.2	60.9	81
1982						7.2				7.2		2.6	0.4	4.6	1.1	3.3	0.5	tr	0.5	13.0	0.4		5.5	38.9	11.7	23.1		79.6	92
1983						7.6	11.3			18.9		0.6	1.1	12.9	1.1	1.6	0.5	0.1	0.4	18.3			3.2	40.4	8.2	10.9	tr	62.7	100
1984	1.3	0.1	-	6.1	0.2	3.1	5.2	1.5	-	17.5	0.2	8.7	4.3	8.2	1.5	3.7	3.7	tr	3.4	33.7			6.3	18.0	12.7	12.7	tr	49.8	83
1976 - 1984	0.2	tr	tr	1.6	0.1	4.9	2.7	0.4	0.1	10	tr	2.3	2.8	9.3	4.4	4.3	4.9	0.6	3.1		0.1	tr	6.0	31.1	10.3	10.5	0.1		

East Coast Vancouver Island = 31.7% of landings

West Coast Vancouver Island = 58.1% of landings

North Coast = 10.0% of landings

South Coast = 89.8% of landings

Table 9 - 1981 Geoduck management - Summary of quotas, landings and closure dates.

Management Units Statistical Areas	Quotas (tonnes)		Landings (tonnes)		Date Area Closed (Quota taken)
North Coast					
Area 1	68		-		December 31, 1981
2E	113		11		December 31
2W	91		-		December 31
3	68		-		December 31
4	113		-		December 31
5	79		84		December 31
6	79	later combined	6.1		Areas 6, 7, 8 closed July 31, 1981
7	79	and increased to	370		October 15 to December 31
8	79	295t +23t (exploratory fishing)*	28		
9	68	later combined	-		December 31
10	68	to 136t	20		December 31
North Coast Quota 986 t			Landings 508 t		
South Coast					
Area 11, 12	2.7	East Coast	-		December 31, 1981
13	18	Vancouver	41		June 27
14	136	Island	180		April 10
15	18	397 t	20	Landings	August 5
16	41		70	547 t	May 2
17, 18	141		199		Open to December 31
19	41		29		September 2
20, 21, 23	238	West Coast	430		**May 27
24	680	Vancouver	1,806	1,648 t	**May 23
25, 26, 27	499	Island 1,417 t	1,398		**Area 25 closed April 3 Area 26 closed April 14 Area 27 open to December 31
South Coast Quota 1,814 tonnes			Landings 2,195 tonnes		
COASTWIDE QUOTA: 2,800 tonnes			TOTAL LANDINGS: 2,704 tonnes		

*Additional quota of 23 t (50,000 lb.) in Area 7 to provide information on stocks October 15 to December 31.
**Closures of areas over herring spawning season.

Table 10 - Monthly geoduck landings by area in 1981 (tonnes) as reported on sales slips.

	NORTH COAST							SOUTH COAST														
								East Coast Vancouver Island								West Coast Vancouver Island						
Month	2E	4	5	6	7	8	10	12	13	14	15	16	17	18	19	20	23	24	25	26	27	Monthly Totals
Jan										29			6.5		0.6		5.2	93	3.6			137
Feb									0.2	52	1.9	15				3.2	9.9	54	187	2.8		326
March									4.9	63		12		3.6		3.0	21	86	220	62		476
April										35		43	10	3.2		0.6	49	221	46	91		500
May									11		1.2		7.7	3.0			102	362				487
June					162	18	20		25		4.9		11	23	3.4							268
July					205					0.7	20		17	7.9	12			1.2	15			280
Aug			34								1.4		7.3	2.3	11			1.3			5.7	63
Sept	11		36										7.6	0.5								54
Oct			2.2	6.1									87		0.8							96
Nov			12		2.9								1.1	0.6								17
Dec																						
Area Totals	11		84	6.1	370	18	20		41	180	29	70	155	44	28	7.6	187	819	473	156	5.7	

East Coast Vancouver Island = 547 tonnes West Coast Vancouver Island = 1648 tonnes

North Coast Total = 508 tonnes South Coast Total = 2195 tonnes **Coastwide Total = 2704 tonnes**

Table 11 - Monthly geoduck landings by area in 1982 (tonnes) as reported on sales slips.

	NORTH COAST	SOUTH COAST													
		East Coast Vancouver Island								West Coast Vancouver Island					
Month	7	12	13	14	15	16	17	18	19	20	23	24	25	26	27	Monthly Totals
Jan				6.0		4.6		1.0			33	13	19	16		93
Feb			0.3	21	21	9.9	9.4				65	80	27	45		278
March		10		48	12	32	7.9				22	144	5.1	200		481
April	133	12	1.2	46		23			14	3.0	31	255	19	260		800
May	72	43	6.1	0.9		16				11	18	214	75	58		514
June	16	26	6.2	8.9		13					3.8	206	100	45		426
July	5.6			7.5								166	101	64		343
Aug		0.6		4.4		3.6						122	19	36		186
Sept				0.5								18				19
Oct																-
Nov																-
Dec																-
Area Totals	227	83	14	144	33	103	17	1.0	14	14	174	1218	366	726	-	

East Coast Vancouver Island = 409 tonnes West Coast Vancouver Island = 2498 tonnes

North Coast Total = 227 tonnes South Coast Total = 2907 tonnes **Coastwide Total = 3134 tonnes**

Table 12 - 1983 Geoduck management - Summary of quotas, landings and closure dates

Management Units Statistical Areas	Quotas (tonnes)		Landings (tonnes)	Date Area Closed (Quota Taken)
North Coast				
Areas 6 to 10	453.5		501	October 15, 1983
3 to 5	159		-	December 31, 1983
1, 2E, 2W	295		-	December 31, 1983
North Coast Quota	907 tonnes	Landings	501 tonnes	
South Coast				
Areas 11 to 19	453.5		569	December 31, 1983
20 to 27	1,587		1,669	July 15, 1983
South Coast Quota	2,041 tonnes	Landings	2,239 tonnes	
Coastwide quota:	2,948 tonnes	Total Landings:	2,740 tonnes	

Table 13 - Monthly geoduck landings by area in 1983 (tonnes) as reported on sales slips.

	NORTH COAST		SOUTH COAST													
			East Coast Vancouver Island								West Coast Vancouver Island					
Month	7	8	12	13	14	15	16	17	18	19	23	24	25	26	27	Monthly Totals
Jan			0.3	2.3	3.4		0.5				11	12	1.2	1.7		33
Feb				0.4	1.0						38	32	5.9	6.8		84
March				2.1	1.0					4.6	10	49	13	52		132
April				2.8	10		5.3				9.1	204	33	59	0.9	324
May				3.5	16		1.6				8.5	276	70	47		423
June					22		4.7				3.2	242	66	56		394
July		13		2.3	18	2.0	19		0.9	1.3	3.8	247	25	61		393
Aug	36	187		1.0	74	5.6	7.5		1.1	3.8		3.7				320
Sept	111	99		1.8	65	2.5	3.2	2.0								285
Oct	55			5.5	112	5.9	0.3						1.1	3.4		183
Nov			4.4	1.0	11	12		4.0								32
Dec			11	6.1	6.4	1.4		7.4								32
Area Totals	202	299	16	29	340	29	42	13	2.0	9.8	84	1066	215	287	0.9	

East Coast Vancouver Island = 481 tonnes West Coast Vancouver Island = 1,653 tonnes

North Coast Total = 501 tonnes South Coast Total = 2,134 tonnes **Coastwide Total = 2,636 tonnes**

Table 14 - 1984 Geoduck management - Summary of quotas, landings and closure dates.

Management Units Statistical Areas	Quotas (tonnes)		Landings (tonnes)		Date Area Closed (Quota taken)
North Coast					
Area 1 and 2W	No quota-exploratory fishing		-		December 31, 1984
2E	294.8		3.6		December 31
3, 4 and 5	158.7		217		September 12
6 to 10	453.5		354		July 20
North Coast Quota 907.2 tonnes			Landings 575 tonnes		
South Coast					
Area 11 and 12	No quota		310		Sept. 28- unfished subareas reopened Nov. 12-Dec. 31
13	90.7		149		Aug. 31 - unfished subareas reopened Nov. 12-Dec. 31
		E. Coast			
14	181.4	Van. Is.	285	Landings	July 13
15 and 16	181.4	680.4 t	183	1,174 t	August 3
17 and 18	113.4		128		April 30
19	113.4		118		August 23
20	No quota		-		Aug. 3 - Aug. 24 - exploratory opening
23	181.4	W. Coast	219		*June 19
24 Inside	204.1	Van. Is.	279	Landings	May 18
outside	294.8	1405.9 t	361	1,734 t	*April 30
25	362.8		442		*July 8
26 and 27	362.8		445		July 18
South Coast Quota 2086.5 tonnes			Landings 2,908 tonnes		
Coastwide quota: 2,993.7 tonnes			Total Landings: 3,482 tonnes		

*Closure of some areas over herring spawning season.

Table 15 - Monthly geoduck landings by area in 1984 (tonnes) as reported on sales slips.

	NORTH COAST							SOUTH COAST													
								East Coast Vancouver Island								West Coast Vancouver Island					
Month	2E	3	5	6	7	8	9	11	12	13	14	15	16	17	19	23	24	25	26	27	Monthly Totals
Jan				7.9					3.8	2.8	0.8	1.4		15		39	43		17		131
Feb									12		7.4	1.1		24		40	51	3.7			139
March									12	1.6	6.0		18	42	1.3		142	7.2	6.4	2.0	239
April							19		13		16	0.5	16	45			229	22	44		405
May							20		24	12	75	0.7	40			20	162	38	83		475
June					5.5	61	15		55	23	102	7.2	25	2		119		234	84		733
July			2.9		103	121			26	4.9	77	41	31		3.9			136	209		757
Aug	3.6	3.4	127						16	103		2.1			113						368
Sept			84					4.8	129	2.5											220
Oct																					
Nov											0.7										0.7
Dec								3.4	12												15
Area Totals	3.6	3.4	214	7.9	109	183	54	8.2	302	149	285	54	129	128	118	219	628	442	443	2.0	

East Coast Vancouver Island = 1,174 tonnes West Coast Vancouver Island = 1,734 tonnes

North Coast Total = 575 tonnes South Coast Total = 2,908 tonnes **Coastwide Total = 3,482 tonnes**

Table 16 - Landed values of geoduck clams, 1977 to 1984 as reported on sales slips

Year	Total Landings (lb.)	Total Landings (kg[3])	Total Value ($)	Mean Price[1] ($/lb.)	Mean Price[1] ($/kg.)	Price Range[2] ($/lb.)	Price Range[2] ($/kg.)
1977	540,898	245,351	89,393.83	0.17	0.36	N/A	
1978	2,239,950	1,016,041	569,288.83	0.25	0.56	0.15 - 0.35	0.33 - 0.77
1979	5,429,886	2,462,996	1,669,447.02	0.31	0.68	0.13 - 0.40	0.29 - 0.88
1980	6,160,903	2,794,586	2,298,655.19	0.37	0.82	0.30 - 0.48	0.66 - 1.06
1981	5,961,405	2,704,093	2,161,948.91	0.36	0.80	0.32 - 0.70	0.71 - 1.54
1982	6,910,800	3,134,738	2,813,787.37	0.40	0.89	0.22 - 0.46	0.44 - 1.01
1983	5,810,913	2,635,830	1,804,388.78	0.31	0.68	0.00 - 0.60	0.00 - 1.32
1984	7,678,465	3,482,951	2,936,602.00	0.38	0.84	0.00 - 0.95	0.00 - 2.09

[1]Price paid to commercial fishermen.

[2]Price ranges taken from Market Reports

[3]lb. converted to kg (x.4536)

Table 17 - Summary of geoduck exports and value by product type, 1981 to 1984.

	1981			1982		
	tonnes	$1000	$/kg	tonnes	$1000	$/kg
Exports[1]						
Frozen neck meat	237	1,683	7.10	411	2,988	7.27
Frozen body meat	22	36	1.63	91	103	1.14
Frozen meat	73	106	1.43			
Frozen steaks	1	1	1.97			
Whole frozen (in shell)	3	22	7.65	6	5	0.88
Live/fresh	69	158	2.29	38	90	2.38
Other	0.3	0.6	1.96	3	21	6.59
Export Totals	405	$2,006	$4.96	548	$3,207	$5.85
Estimate of Exports as % of total landings[2]	Exports less than 50% of landings (data incomplete)			Exports less than 70% of landings (data incomplete)		
Total landings (tonnes)[3]	2704 tonnes			3135 tonnes		

Table 17 (continued) - Summary of geoduck exports and value by product type, 1981 to 1984.

	1983			1984		
	tonnes	$1000	$/kg	tonnes	$1000	$/kg
Exports[1]						
Frozen neck meat	419	2,951	7.05	437	3,186	7.29
Frozen body meat	158	187	1.18	105	115	1.38
Whole frozen (in shell)	0.1	*	0.56	0.2	*	2.02
Live/fresh	252	387	1.54	190	407	2.14
Export Totals	829	3,525	4.25	732	3,738	5.10
Estimate of Exports as % of total landings[2]	Exports 92% of Landings			Exports 64% of Landings		
Total landings (tonnes)[3]	2,636 tonnes			3,482 tonnes		

[1]Data from Annual Fish Product Exports of British Columbia (Economics and Statistics, D.F.O., Pacific Region). Figures do not include exports from other Canadian points.
[2]Export product weights were converted back to whole weights to compare to reported landings.
[3]Landings of whole round weights as reported on sales slips.

All values are in Canadian dollars.

*Less than $500

Table 18: Geoduck exports, production statistics and landings for 1981

	Japan			U.S.A.			Hong Kong			Taiwan			Other			Totals		
	tonnes	$'000	$/kg	tonnes	$'000	$/kg	tonnes	$'000	$/kg	tonnes	$'000	$/kg	tonnes	$'000	$/kg	tonnes	$'000	$/kg
Export Declarations[1]																		
Frozen neck meat	217	1,550	7.12	-	-	-	14	100	6.95	-	-	-	5	34	6.53	237	1,683	7.10
Frozen body meat	12	28	2.38	-	-	-	-	-	-	9	6	0.30	1	2	1.48	22	36	1.63
Meat				73	105	1.43							0.1	0.5	5.82	73	106	1.43
Whole frozen (in shell)	2	18	7.98	0.6	4	6.33	-	-	-	-	-	-				3	22	7.65
Live/fresh (in shell)				58	120	2.07							10	38	3.62	69	158	2.29
Others													0.3	0.6	1.96	0.3	0.6	1.96
													1981 Export Totals:			405	$2,006	$4.96
B.C. Production Statistics[2]																		
Neck meat																389	2,598	6.68
Body meat																97	135	1.39
Live																1,103	1,017	0.92
Other																-	19	-
													1981 Processed Totals:			1,589	$3,769	$2.37
Landings - Whole/ Round weights[3]													1981 Landings Totals:			2,704	$2,162	$0.80

[1]Data from 1981 Fish Product Exports of British Columbia (Economics and Statistics, D.F.O., Pacific Region). Figures do not include exports from other Canadian Points, e.g. shipping from Toronto.
[2]Data from Fisheries Production Statistics of B.C., Ministry of Environment, Government of British Columbia.
[3]Landings as reported on sales slips. Values are landed values to fishermen.

All values are in Canadian dollars.

Table 19: Geoduck exports, production statistics and landings for 1982

	Japan			U.S.A.			Hong Kong			Other			Totals		
	tonnes	$'000	$/kg	tonnes	$'000	$/kg	tonnes	$'000	$/kg	tonnes	$'000	$/kg	tonnes	$'000	$/kg
Export Declarations[1]															
Frozen neck meat	309	2,482	8.03	80	367	4.57	14	118	8.12	7	21	3.09	411	2,988	7.27
Frozen body meat	13	12	0.89	72	84	1.17	-	-	-				91	103	1.14
Whole frozen (in shell)													6	5	0.88
Live/fresh (in shell)	-	-	-	37	87	2.36				0.6	2	3.65	38	90	2.38
Other													3	21	6.59
1982 Export Totals:													548	$3,207	$5.85
B.C. Production Statistics[2]															
Neck meat													669	4,610	6.89
Body meat													304	271	0.89
Live/fresh													132	261	1.98
Other													10	20	2.00
1982 Processed Totals:													1,115	$5,162	$4.63
Landings - Whole/ Round weights[3]													3,135	$2,814	$0.89
1982 Landing Totals:															

[1]Data from 1982 Fish Product Exports of British Columbia (Economics and Statistics, D.F.O., Pacific Region). Figures do not include exports from other Canadian Points, e.g. shipping from Toronto.
[2]Data from Fisheries Production Statistics of B.C., Ministry of Environment, Government of British Columbia.
[3]Landings as reported on sales slips. Values are landed values to fishermen.

All values are in Canadian dollars.

Table 20: Geoduck exports, production statistics and landings for 1983

	Japan			U.S.A.			Hong Kong			Taiwan			Other			Totals		
	tonnes	$'000	$/kg	tonnes	$'000	$/kg	tonnes	$'000	$/kg	tonnes	$'000	$/kg	tonnes	$'000	$/kg	tonnes	$'000	$/kg
Export Declarations[1]																		
Frozen neck meat	346	2494	7.10	49	316	5.47	23	140	5.99	-	-	-	0.4			419	2,951	7.05
Frozen body meat	-	-	-	136	161	1.18	4	7.4	1.69	18	18.8	1.05	4	-	-	158	187	1.18
Whole frozen (in shell)													0.1	*	0.56	0.1	*	0.56
Live/fresh (in shell)				251	386	1.54							0.62	2	2.14	252	387	1.54
													1983 Export Totals:			829	$3,525	$4.25
B.C. Production Statistics[2]																		
Neck meat																496	3,271	6.59
Body meat																263	530	2.02
Live																243	397	1.63
Other																-	4	-
													1983 Processed Totals:			1,002	$4,202	$4.19
Landings - Whole/ Round weights[3]													1983 Landing Totals:			2,636	$1,804	$0.68

[1]Data from 1983 Fish Product Exports of British Columbia (Economics and Statistics, D.F.O., Pacific Region). Figures do not include exports from other Canadian Points, e.g. shipping from Toronto.
[2]Data from Fisheries Production Statistics of B.C., Ministry of Environment, Government of British Columbia.
[3]Landings as reported on sales slips. Values are landed values to fishermen.

All values are in Canadian dollars.

*Less than $500

Table 21: Geoduck exports, production statistics and landings for 1984

	U.S.A.			Other			Totals		
	tonnes	$'000	$/kg	tonnes	$'000	$/kg	tonnes	$'000	$/kg
Export Declarations[1]									
Frozen neck meat	100	663	6.65	338	2,523	7.47	437	3,186	7.29
Frozen body meat	96	130	1.36	9	14	1.61	105	145	1.38
Whole frozen (in shell)	0.2	*	2.02				0.2	*	2.02
Live/fresh (in shell)	190	407	2.14	0.1	*	3.31	190	407	2.14
1984 Export Totals:							732	3,738	5.11
B.C. Production Statistics[2]									
Neck meat							645	4,060	6.30
Body meat							262	474	1.81
Live							372	634	1.70
Other							-	7	-
1984 Processed Totals:							1,279	5,175	4.05
Landings - Whole/ Round weights[3]									
1984 Landing Totals:							3,483	2,937	0.84

[1]Data from 1984 Fish Product Exports of British Columbia (Economics and Statistics, D.F.O., Pacific Region). Figures do not include exports from other Canadian Points, e.g. shipping from Toronto.

[2]Data from Fisheries Production Statistics of B.C., Ministry of Environment, Government of British Columbia.

[3]Landings as reported on sales slips. Values are landed values to fishermen.

All values are in Canadian dollars.

*Less than $500

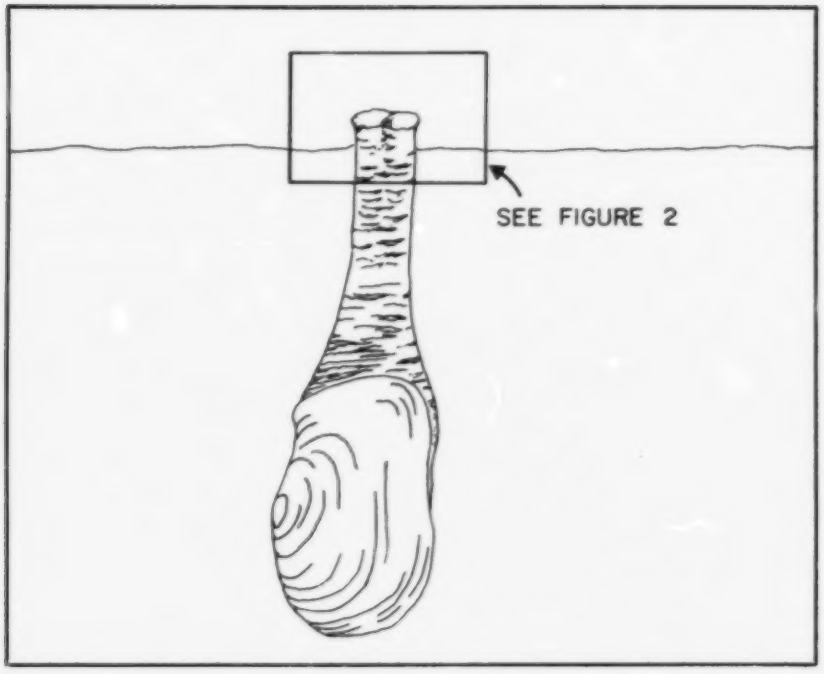

Fig. 1. Geoduck clam buried in substrate.

Fig. 2. Geoduck clam show.

Figure 3. Geoduck diver with water hose and nozzle ('stinger').

Figure 4. Geoduck clam harvest.

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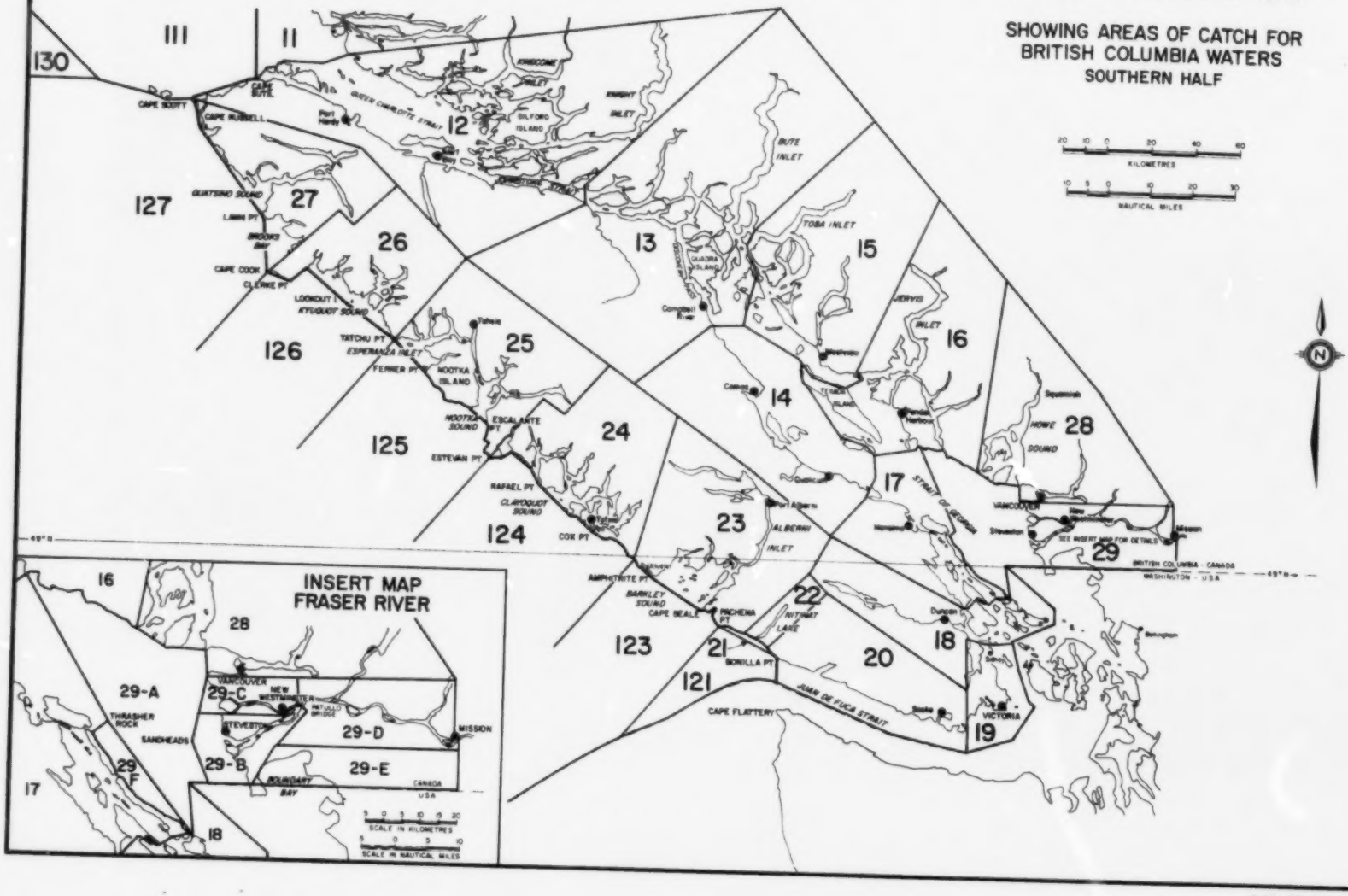
STATISTICAL AREA MAP

SHOWING AREAS OF CATCH FOR BRITISH COLUMBIA WATERS SOUTHERN HALF



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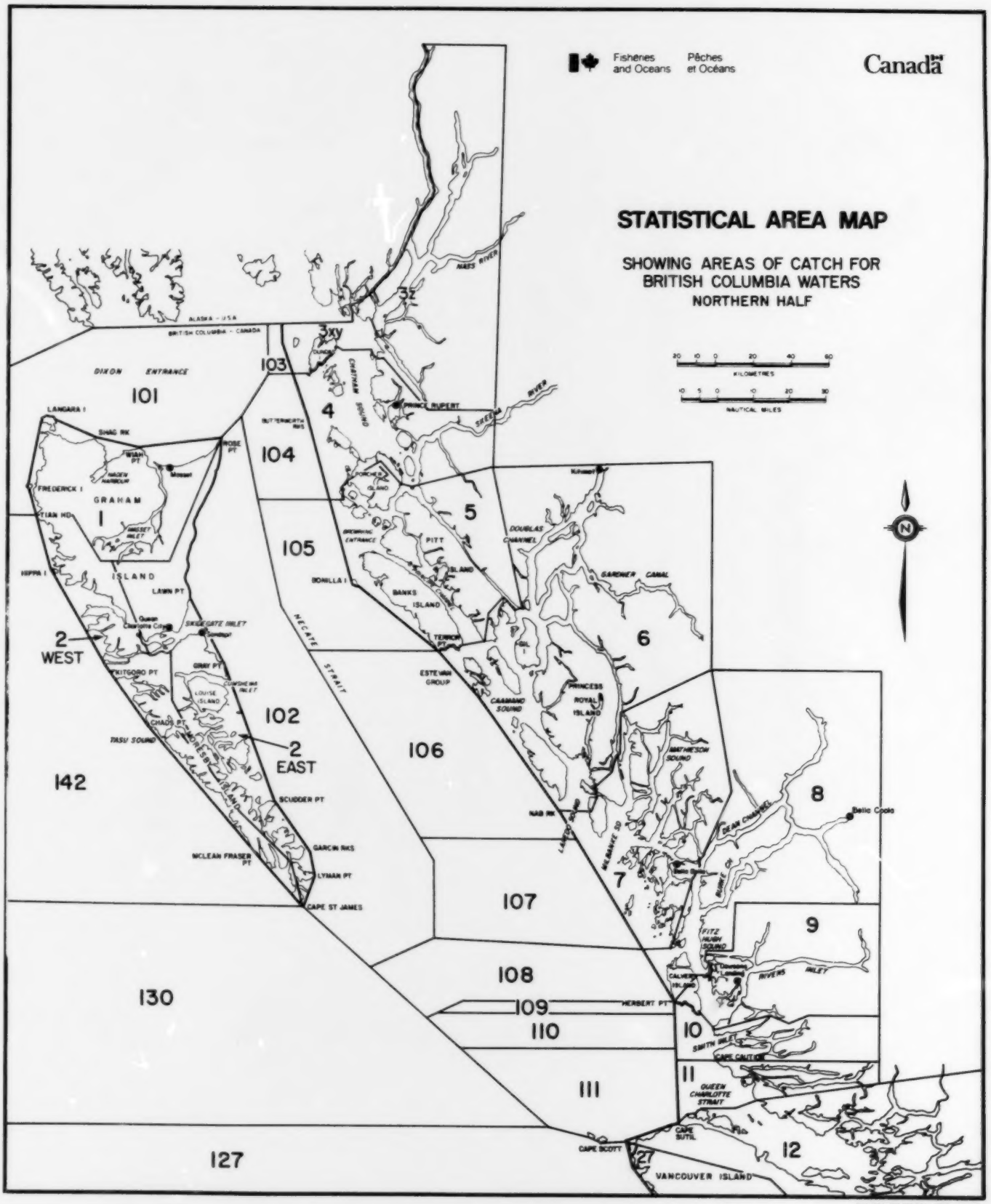
Fisheries and Oceans
Pêches et Océans
Canada
STATISTICAL AREA MAP
SHOWING AREAS OF CATCH FOR
BRITISH COLUMBIA WATERS
NORTHERN HALF
KILOMETRES
NAUTICAL MILES
ALASKA - USA
BRITISH COLUMBIA - CANADA
DIXON ENTRANCE
101
103
3z
3xy
4
104
105
5
6
7
8
9
10
11
12
102
106
107
108
109
110
111
127
130
142
1
GRAHAM
ISLAND
2
WEST
2
EAST
PRINCE RUPERT
VANCOUVER ISLAND
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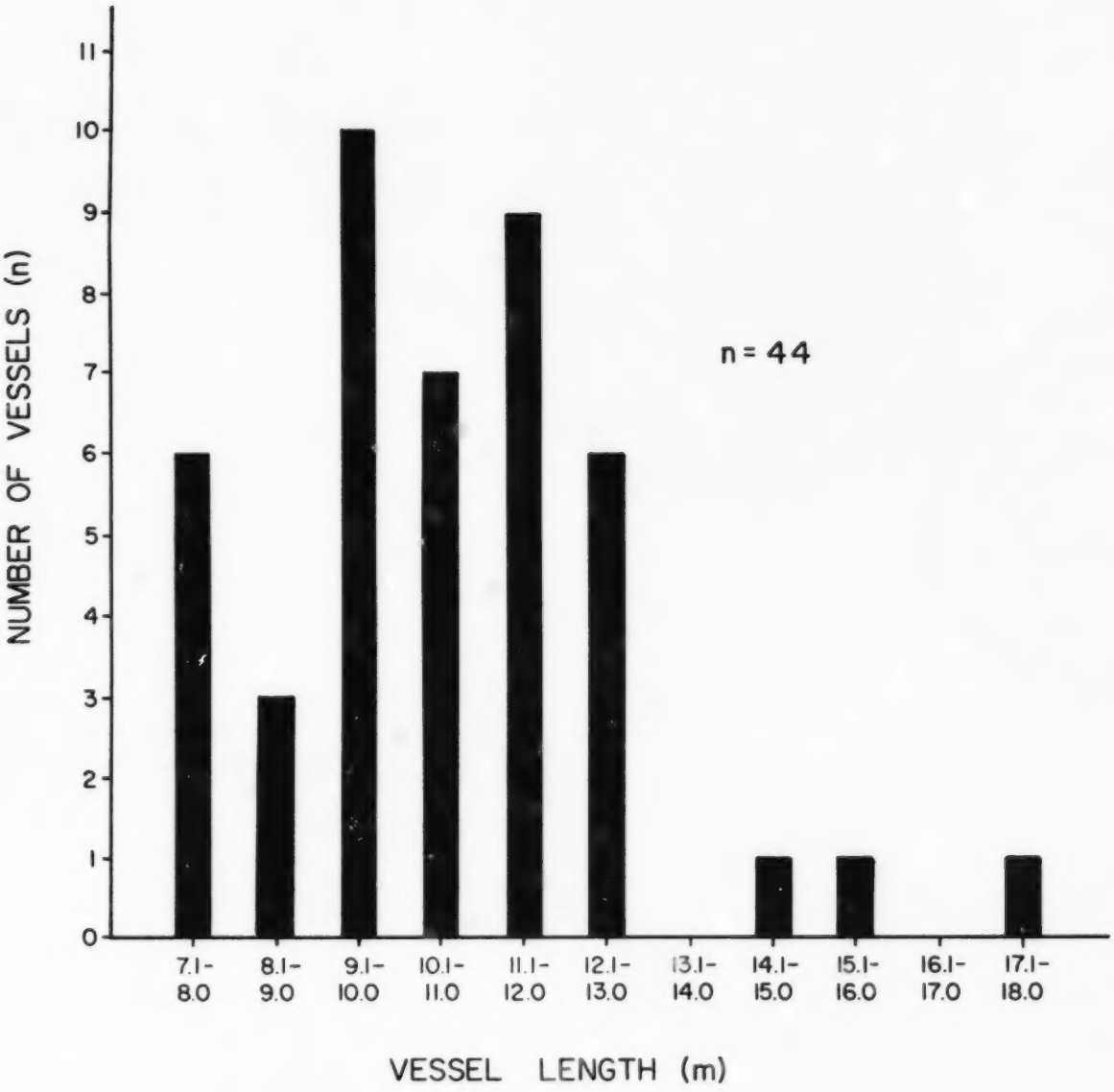

Fig. 6. Size of vessels active in the geoduck fishery, 1984.

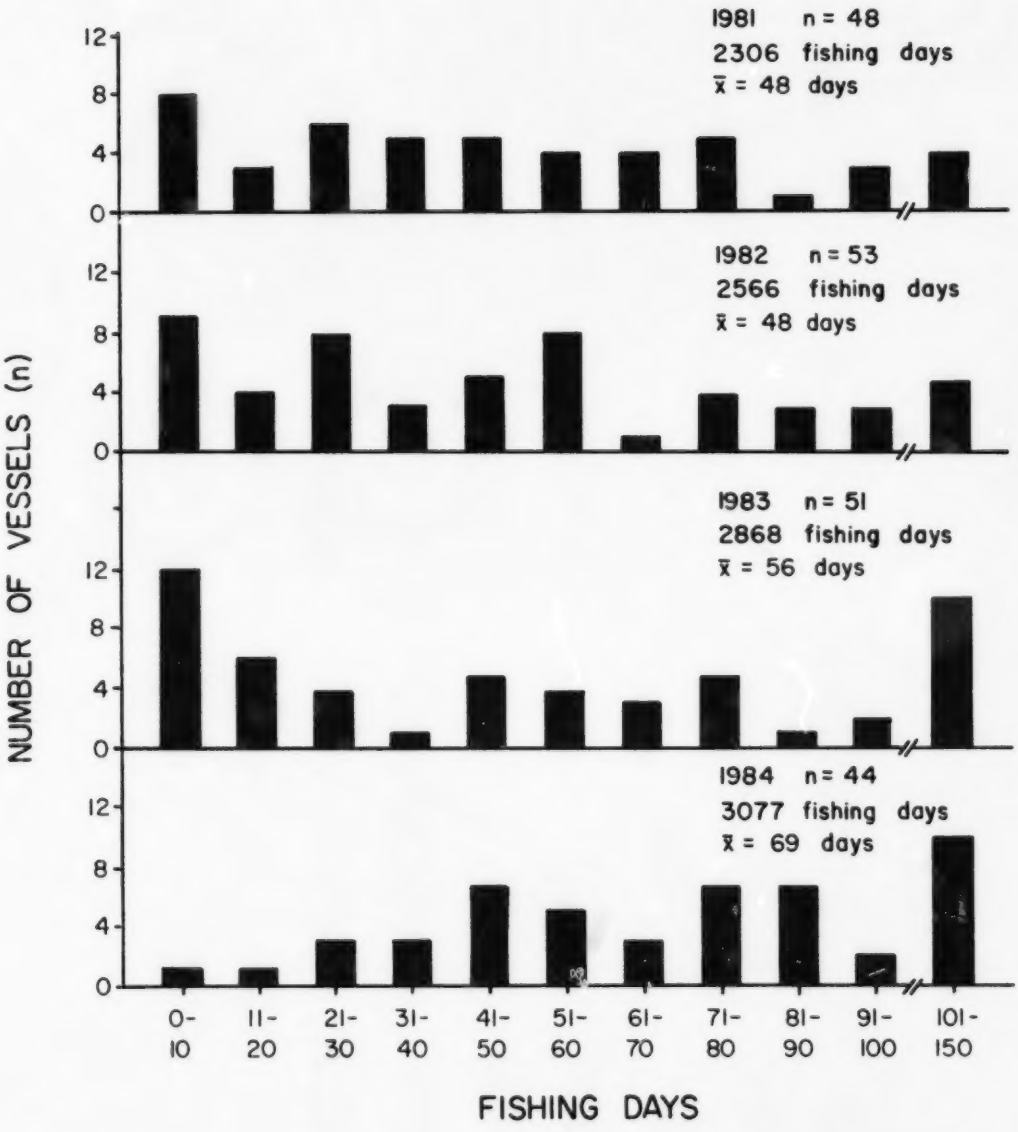

Fig. 7. Distribution of vessel effort in the geoduck fishery as reported on sales slips, 1981 to 1984.

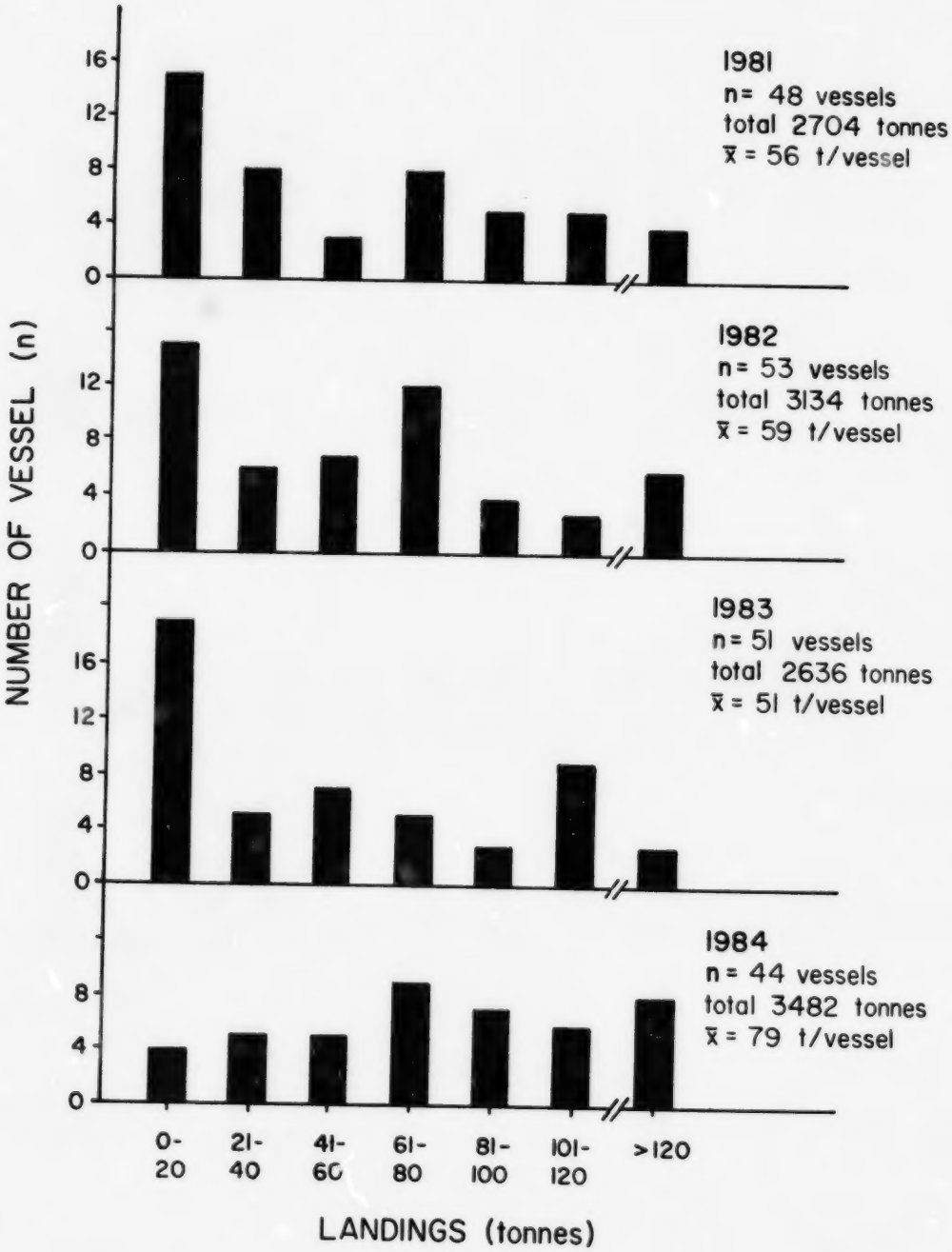

Fig. 8. Distribution of annual vessel catch of geoducks as reported on sales slips, 1981 to 1984.

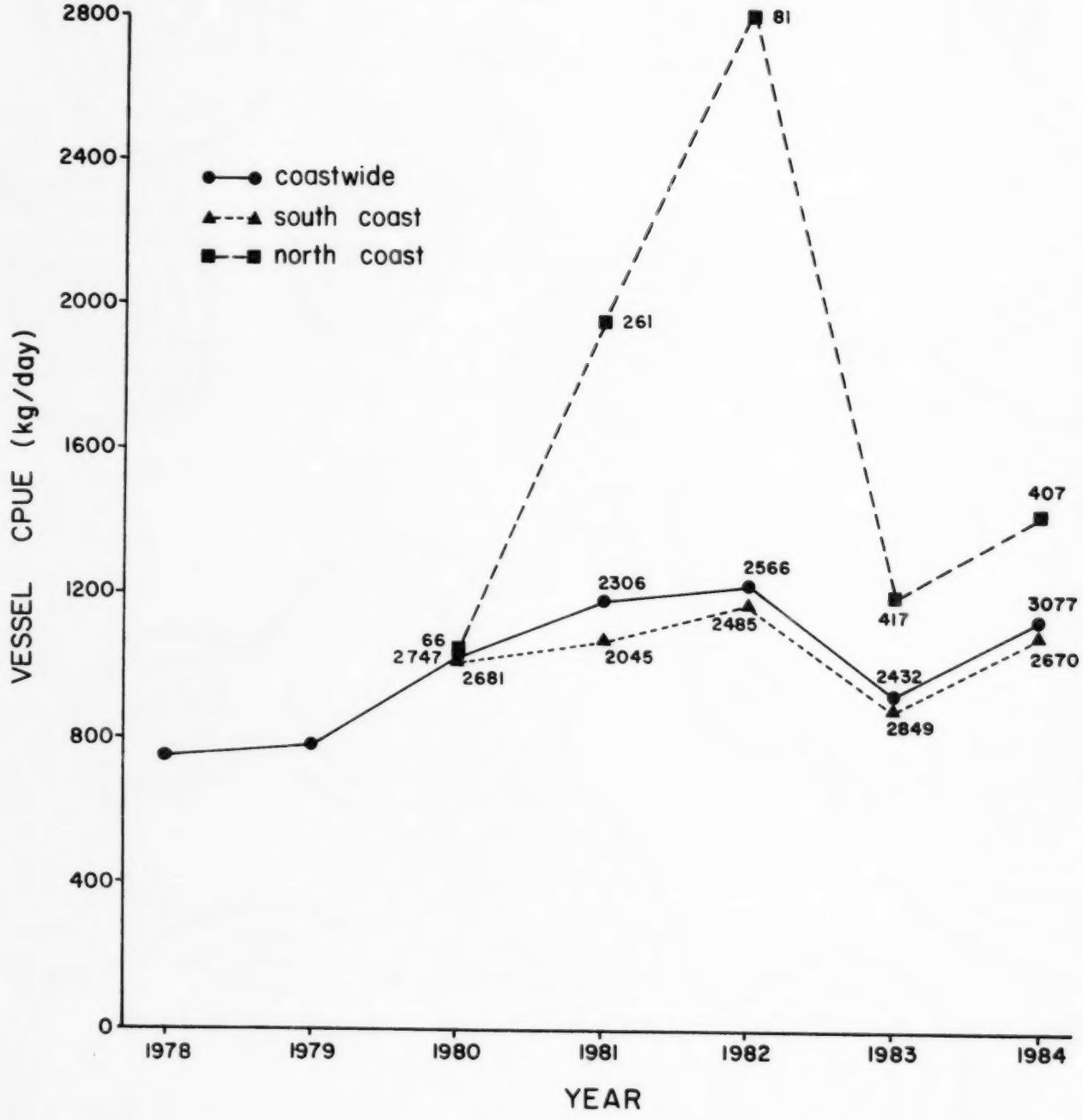

Fig. 9. Vessel catch per unit effort (kg/day) as reported on sales slips, 1978 to 1984. Numbers refer to vessel days fished.

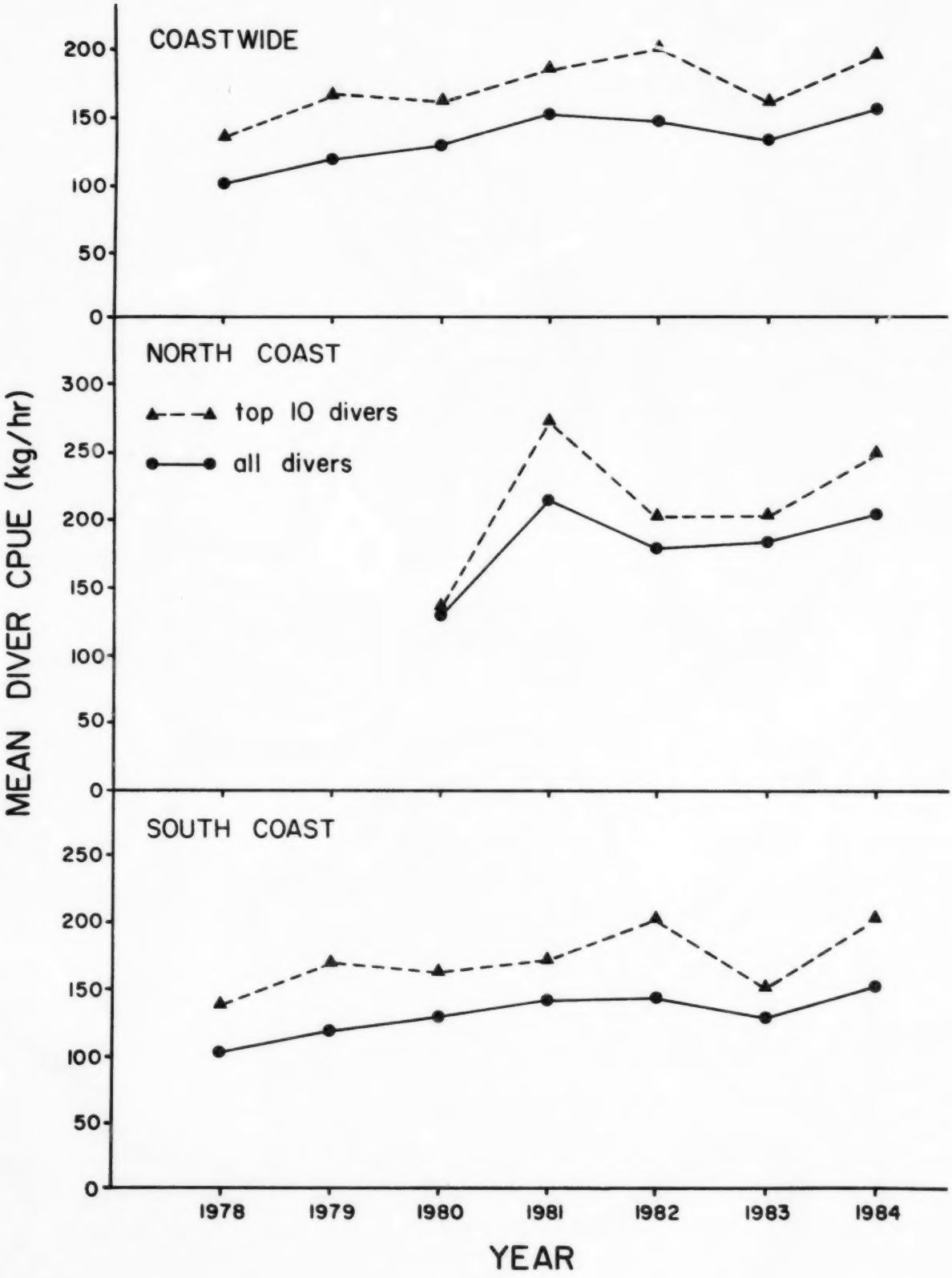

Fig. 10. Mean diver catch per unit effort as reported on harvest logs, 1978 to 1984.

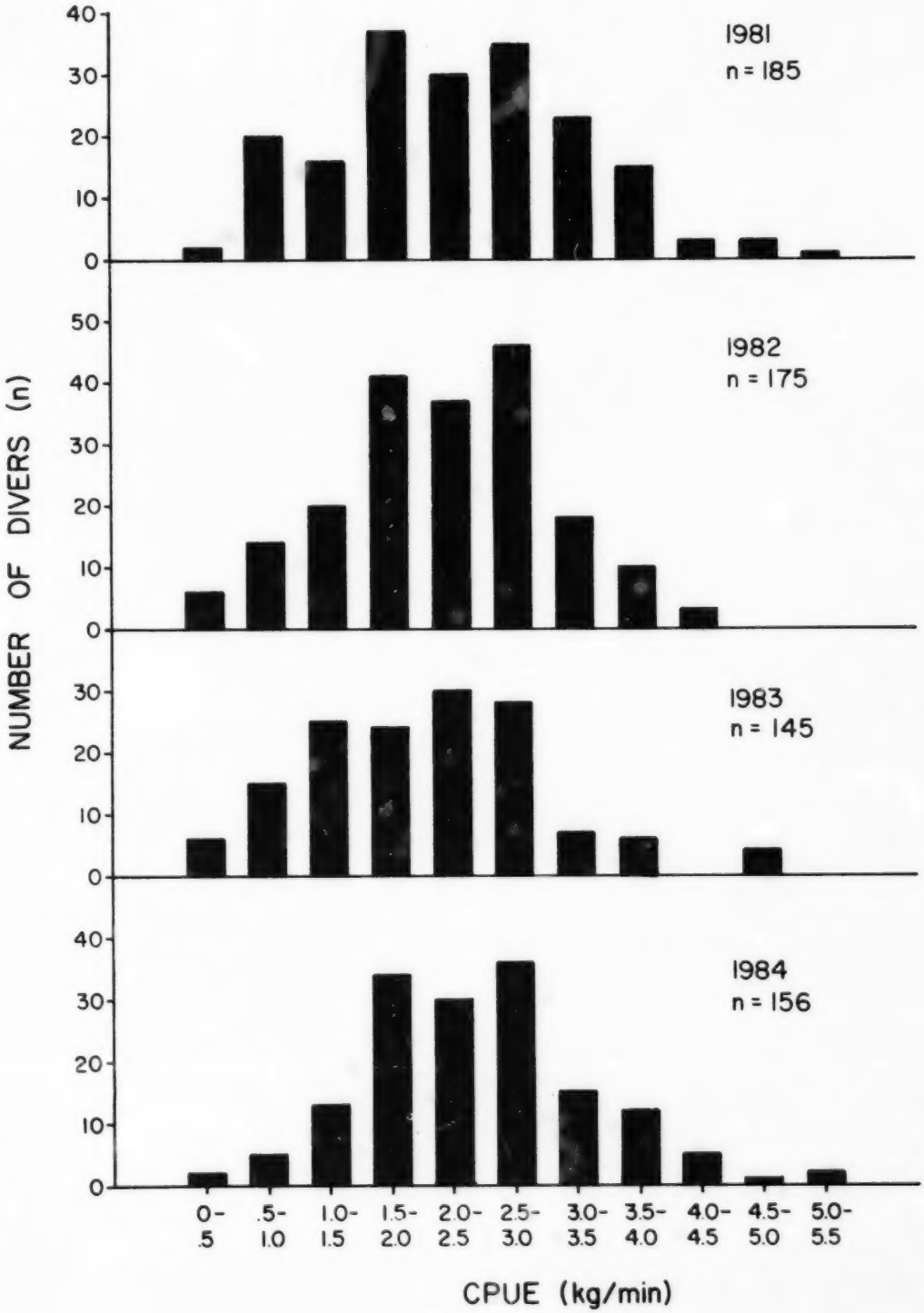

Fig. 11. Distribution of diver catch per unit effort, 1981 to 1984. Divers fishing 5 days or less not included.

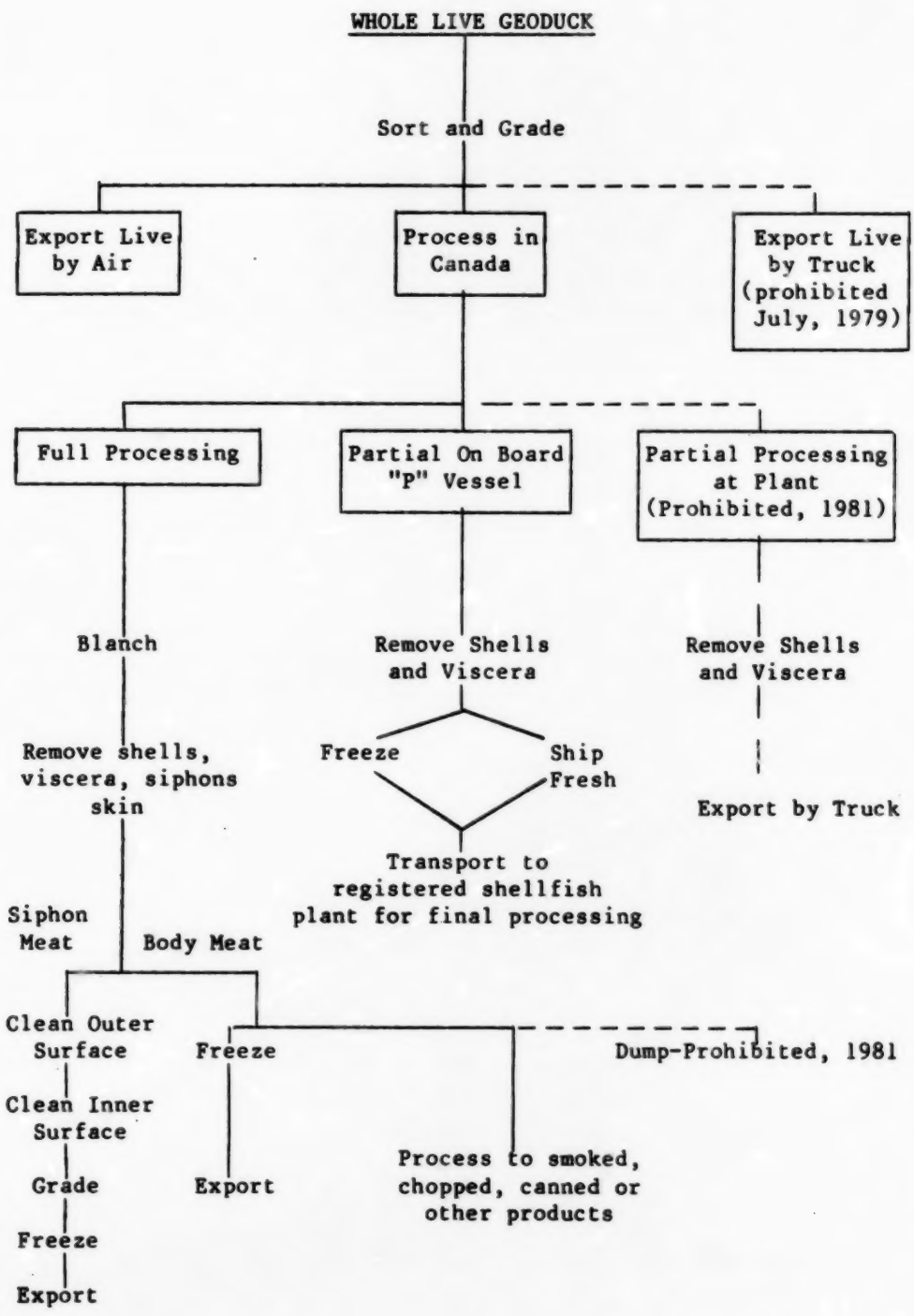

FIGURE 12: Processing of Geoducks

APPENDIX 1

PERMANENT CLOSURES AND STUDY AREAS

The following areas are closed under conditions of the G licence:

No person shall fish for, take, catch or have in possession geoducks in the following areas:

i) All harvesting of geoducks and horseclams shall be conducted from bottoms deeper than 10 feet below chart datum (i.e. deeper than 10.0 feet).

ii) Any area closed by notice, or Schedule I of the Pacific Shellfish Regulations, considered to be contaminated areas.

iii) Area 23 - Bamfield Marine Station Study Area: - All waters of Pacific Fishery Management Area 23 bounded by a line commencing at the light at Whittlestone Point and running directly to the southern tip of Haines Island, from the northwestern tip of Haines Island to the southern tip of Seppings Island; from the northwestern tip of Seppings Island to Kirby Point on Diana Island; from Kirby Point directly to the northwest tip of Fry Island; from the northwestern tip of Fry Island to the nearest adjacent point on Tzartus Island; from Foucault Bluff on Tzartus Island to the northwestern tip of Nanat Island; from the eastern tip of Nanat Island to the nearest adjacent point on Vancouver Island and thence along the coastline of Vancouver Island to the point of commencement.

iv) Area 23 - Waters of Pacific Rim Park - Long Beach and Broken Islands Group.

v) Area 24 - Research Areas and Closures:

a) The east coast of Dunlap Island, from the most northerly point of Dunlap Island to a strait line to Robert Point on Meares Island, then following the Meares Island shore southerly to a point true east of the most southerly point of dunlap Island, then a straight line to the most southerly point of Dunlap Island.

b) Ritchie Bay from Robert Point on Meares Island, then following the shore easterly to the most easterly point of Ritchie Bay, then a straight line to Robert Point.

c) Ahous Bay whale sanctuary. A portion of Subareas 24-6, inside of a straight line from Ahous Point on Vargas Island, thence northerly to a point 0.7 miles northeasterly of lthe most eastern point of Blunden Island.

d) Hesquiat Harbour - the waters inside a strait line between Matlahaw Point to Hesquiat Point.

vi) Area 17 - Research Areas

a) Hammond Bay - inside a line from Neck Point to Lagoon Head.

b) The south shore of Gabriola Island, a portion of Pacific Fishery Management Area 17-4.

APPENDIX 2

PACIFIC SHELLFISH REGULATIONS

Section 23. No person shall dump any edible meat of geoduck or horse clams, including the siphon and body:

a) on, in or near any water of the Province; or

b) on any land in the Province.

Section 24.

1. No person shall fish for geoducks or horse clams by means of diving other than between 0600 hours and 1800 hours in any day.

2. No person engaged in or assisting in fishing geoducks or horse clams by means of diving shall use artificial lights either above or below the water.

APPENDIX 3

RECOMMENDATIONS OF THE PEARSE COMMISSION

"Licencing the smaller commercial fisheries, p. 139:

61. Initial 10-year geoduck quota licences should be issued in 1983 to owners of licensed geoduck vessels that reported landings of geoducks in 1980 or 1981. The quota for which each licensee is eligible should be related to his reported landings in those years.

62. A total allowable catch should be calculated for each of the zones and reserve set aside for appeals.

63. Licensees should be required to select the zones in which their quotas will apply, and the new licences should be issued accordingly.

64. The management practice of closing areas should be discontinued; and, subject to conservation requirements, licensee should be free to take their authorized catches whenever it is most advantageous to do so.

For the longer term development of this fishery, the Department, in consultation with the geoduck licensees in each zone, should begin to identify appropriate goeduck management areas and their sustainable yields, with a view toward identifying mariculture lease areas for licensees' quotas in future.

The transition to quota licences will have several important benefits: it will eliminate incentives to overexpand fishing capacity; it will facilitate management and regulation of the catch by areas; and it will afford greater security to licensees. Geoducks are harvested by divers using a slow and easily controllable process, which, coupled with large stocks relative to annual harvests, will enable licnesees to meet their harvest targets exactly.

Licensees will be able to pace their harvesting to best advantage, avoiding the competitive haste that has necessitated manipulatiing area openings and closures to achieve the target harvests. There has been occasional overharvesting of some areas because of difficulties iin monitoring catches. Abolishing the restrictions on vessels would free those whose small boats confine them to southern waters to acquire the quotas and vessels that would enable them to utilize less heavily exploited northern stocks.

Individual quotas for this fishery present some special problems, however. First, geoducks (unlike abalone) are landed fresh and are delivered almost daily to shore facilities scattered along the coast; and this obviously complicates the task of monitoring landings. However, virtually all geoducks are exported through less than 10 processing companies, and this will facilitate surveillance of catches.

Second is the problem of dark flesh. Some geoducks have a dark outer skin, and although this does not affect the taste of the product it makes them difficult to market. Attempts to solve the problem by scrubbing away the dark colour by hand or by jets of water have been only partially successful. Processors have sometimes refused to buy dark geoducks and fishermen have been forced to dump them. Fishermen attempt to avoid beds with high proportions of dark geoducks, but where this is not successful they are typically dumped, with few, if any, survivors.

Obviously, if quotas are based on the total stock and licensees fill their quotas while discarding all dark geoducks, the total demand on them will be excessive. A solution to this problem is not obvious, but it is not one that is unique to a quota system. If dark geoducks prove to be unmarketable, estimates of the harvestable stocks and allowable catches should be reduced by the proportion of the stock that is not interchangeable."

Other advantages of vessel quotas and area licences include the following:

1. A year round supply of geoducks could be supplied to the market. This should improve market prices, particularly for live markets and minimize processing costs through an improved regulated control of the quantity of geoducks.

2. Licensees with more than one vessel could reduce their operating costs significantly by combining their quotas on one vessel.

APPENDIX 4
PACIFIC FISHERY REGULATIONS AND LICENCING REGULATIONS

CATEGORY "G" LICENCE (1983)

Geoduck and Horse Clam Fishery

61. No person shall use a commercial fishing vessel in harvesting geoducks and horse clams by means of diving unless a Category G licence has been issued in respect of that vessel.

62.(1) Subject to subsection (2), a Category G licence shall be issued in respect of a commercial fishing vessel if

(a) the owner and the vessel meet the conditions and requirements set out in section 26;

(b) the owner records and submits such information as the Minister or a fishery officer may require pursuant to section 48 of the Act;

(c) notwithstanding section 50, the owner surrender the Category C licence entitlement for that vessel prior to the issue of the Category G licence; and

(d) the owner produces documents showing that

i) he was authorized in writing by the Regional Director to harvest geoducks and horse clams by means of diving from a commercial fishing vessel and has marketed a minimum of 13,400 kg of both species, in any combination, during

(A) the year 1978, or

(B) the period commencing January 1, 1979 ending March 31, 1980; or

ii) he was authorized in writing by the Regional Director as a first time participant in the geoduck and horse clam fishery to harvest those species by means of diving from a commercial fishing vessel and marketed a minimum of 13,500 kg of both species in any combination, during the period commencing June 13, 197[illegible] and ending December 31, 1980.

(2) A Category G licence shall not be issued in respect of a vessel greater in overall length than the vessel authorized in writing by the Regional Director to be used in 1982 by the owner to harvest geoducks or horse clams.

63. Subject to regulations made under the Act and in order to ensure the proper management and control of the geoduck and horse clam fishery, a Category G licence may specify the following conditions in respect of that fishery:

(a) the commencement and termination dates of the fishery;

(b) the Area and location of the fishery;

(c) the manner of disposing of any incidental catch;

(d) the maximum weight of fish that may be caught; and

(e) the means of handling and storing the catch on board the vessel.

64. Commencing January 1, 1984, a Category G licence shall not be issued in a licence year in respect of a commercial fishing vessel unless:

(a) the owner and the vessel meet the conditions and requirements set out in Section 26; and

(b) a Category G licence was issued in respect of that vessel in the preceding licence year.

APPENDIX 5

PACIFIC SHELLFISH REGULATIONS - Export of Clams (1984)

20.1 (1) No person shall export from Canada any geoduck unless

a) the shell and viscera have been removed;

b) the body meat has been processed pursuant to the Fish Inspection Act; and

c) the siphon meat is

i) skinned and washed
ii) frozen, smoked, canned or dried or cured in salt, and
iii) packed in containers not exceeding 15 kg net weight.

(2) Subsection (1) does not apply to geoduck clams in the shell if the clams are exported by air carrier.

23. No person shall dump any edible meat of geoduck or horse clams, including the siphon and body

a) on, in or near any water of the Province; or

b) on any land in the Province.